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SUPERIOR VENA CAVA AND INNOMINATE VEINS

ANGIOCARDIOGRAPHIC STUDY*†

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SIGNIFICANT abnormalities of the superior vena cava and innominate veins result from a variety of mediastinal, cardiac and pulmonary diseases. Because of the intimate relation of the superior vena cava to the mediastinum, recognition of these changes during routine roentgenologic study of the chest is difficult. By means of angiocardiography,[46,47] the superior vena cava and innominate veins can be visualized and abnormalities demonstrated. It is the purpose of this report to present a study of the normal and the pathologic superior vena caval system based upon over 1,500 angiocardiographic examinations made between 1937 and the present.

THE NORMAL SUPERIOR VENA CAVA AND INNOMINATE VEINS

The normal superior vena cava is a short, broad vein measuring about 7 cm. in length. It takes origin at the junction of the two innominate veins below the cartilage of the right first rib close to the sternum, and descends vertically behind the first and second intercostal spaces to end in the upper part of the right atrium opposite the border of the third right costal cartilage. The lower half of the vessel lies within the pericardium. The superior vena cava passes in front of the root of the right lung and the right vagus nerve and descends to the right of the ascending aorta which overlaps it near the atrium. Just before it enters the pericardium, it receives the azygos vein. The anterior and posterior boundaries of the superior mediastinum, the sternum and spine, are relatively firm structures. It is not surprising that distortion and compression of this vessel frequently results from disease of the closely related aorta, trachea and right bronchus.

The innominate veins are formed by the union of the internal jugular and subclavian veins of the corresponding sides. Postmortem measurements have indicated that the right innominate vein averages 2 to 3 cm. in length; the longer left innominate vein is an average 6 to 7.5 cm. long.[34] The right innominate vein begins behind the sternal end of the right clavicle and passes almost vertically downward, joining with

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the left innominate to form the superior vena cava. It lies closely in front of and to the right of the innominate artery, and receives the right vertebral, internal mammary and inferior thyroid veins. The left innominate vein begins behind the sternal end of the left clavicle, running obliquely downward and to the right to join the right innominate. It passes in front of the left subclavian, left common carotid and innominate arteries as well as the trachea, and is related to the aortic arch inferiorly. It receives the same tributaries as the right.

Hinshaw and Rutledge[28] state: "The large mediastinal veins are thin walled and the blood flowing through them is under very low pressure. Furthermore, these veins are anteriorly situated nearer the unyielding bony thoracic cage, against which they may be compressed by expanding mediastinal lesions—obstruction to flow of blood in these important channels will produce localized symptoms and signs pathognomonic of a mediastinal lesion. Since these vessels are readily compressed, such manifestations may be early indications (sometimes even initial symptoms) of serious mediastinal disease." McIntire and Sykes[41] stress that important lymph nodes including those of the right anterior mediastinal and the right laterotracheal chains as well as the right bronchial nodes and some of the nodes of the tracheal bifurcation are in close association with the superior vena cava. Most of the structures of the right thoracic cavity, mediastinum and part of the structures of the left thoracic cavity, drain into lymph nodes related to the superior vena cava. Neoplastic and inflammatory disease in this part of the body offers a constant threat to these lymph nodes with possible resultant obstruction of the superior vena cava from extrinsic pressure or invasion.

Conventional roentgen examination offers information concerning the superior vena caval system to a limited degree. In frontal projection, the right upper mediastinal border is formed by the right innominate vein and the superior vena cava, the latter blending below into the right atrial shadow. Variations in size and shape of these vessels are poorly shown by conventional roentgen examination since the inner borders and lumina are invisible.

Angiocardiographic examination of the superior vena cava and innominate veins in contrast to the more indirect clinical methods affords exact anatomic observations. In the frontal projection the normal right innominate vein and the superior vena cava are seen to form the right superior mediastinal border (Fig. 1 and 2). The superior vena cava blends smoothly into the right atrium below the level where it crosses the right pulmonary artery. The right innominate vein appears as a nearly vertical shadow, its lower limit being difficult to delineate unless the left innominate vein is viewed. The upper limit of both innominate veins is sharply demarcated at the junction of the internal jugular and subclavian veins at or above the clavicle. The left innominate vein makes a greater angle with the vertical, and its lower limit is therefore more readily identified. This angle varies with body habitus, age and as the result of intrathoracic abnormalities.

The superior vena cava is longer during the inspiratory as compared to the expiratory phase, a fact not taken into consideration here since deep inspiration is routine during roentgenography. Rapid serial angiocardiography with electrocardiographic control[25] has indicated a systolic-diastolic variation in the size of the superior vena cava. Respiratory action may result in marked variations in intrathoracic pressure and could be expected to play a more significant role in the alteration of superior vena caval pressure (and therefore size) than the mechanical effects of the angiocardiographic injection itself. Cardiac catheterization studies[21] failed to show significant variation in right atrial pressure with such injections. These facts notwithstanding, measurement studies of the superior vena cava were believed to be of value and were therefore undertaken.

The range in caliber of the superior vena

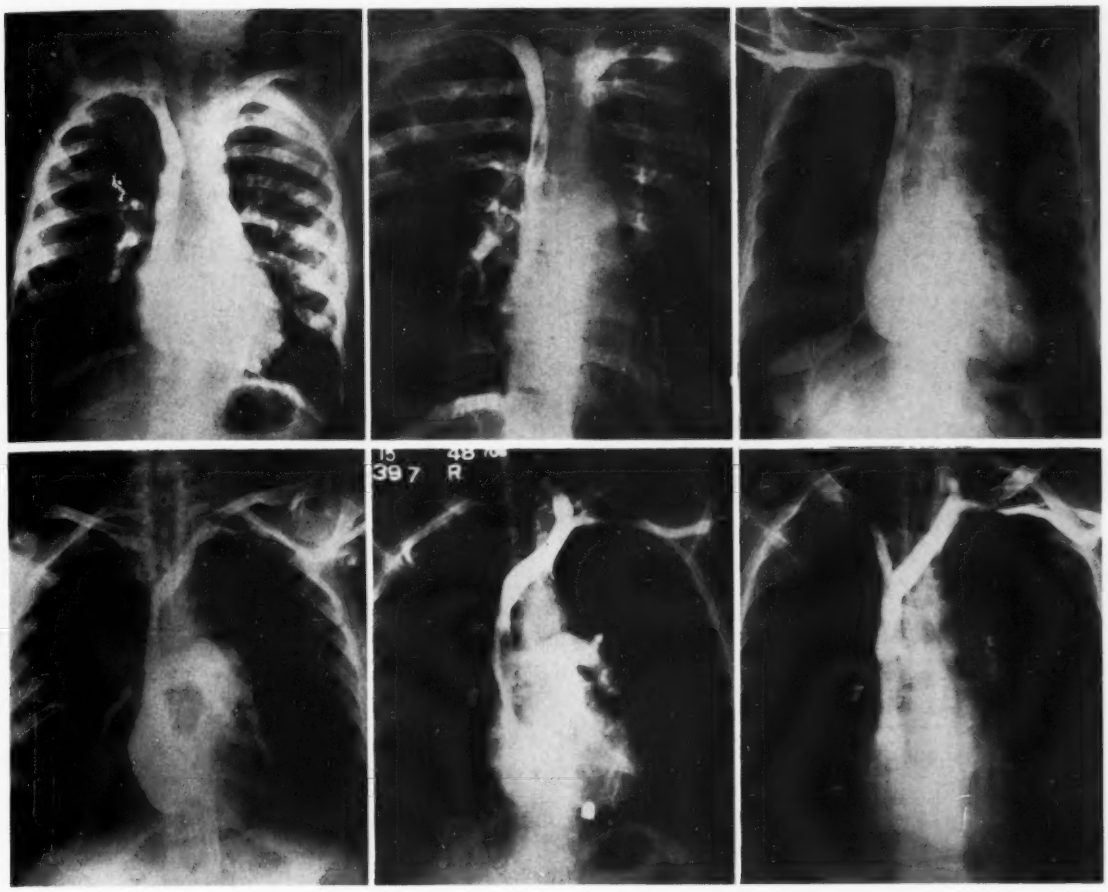

Fig. 1. *Normal Superior Vena Cava and Innominate Veins.* Six angiocardiograms in frontal projection demonstrate normal variations in size, shape and position of the superior vena cava and innominate veins.

cava as observed angiocardiographically is fairly wide. A previously published angiocardiographic study[16] indicated that the upper limit of normal caliber was 20 mm., measurement being made where the superior vena cava crossed the right pulmonary artery. In the present investigation these preliminary studies were considerably expanded upon. Measurements of length and caliber were carefully conducted on the angiocardiograms of 150 patients who had no angiocardiographic or clinical evidence of superior vena caval disease. All measurements were taken from frontal angiocardiograms made during inspiration at a 72 inch target-film distance. Points of measurement are shown in Figure 2 and are described in the legend. The superior vena cava was found to vary from 8 to 20 mm. in caliber, averaging 14.8 mm. (S.D. ± 2.8). Its length ranged from 4.2 cm. to 12.0 cm., averaging 7.7 cm. (S.D. ± 1.5). The right innominate vein ranged from 5 to 17 mm. in caliber, averaging 9.5 mm. and in length was found to range from 2.0 to 7.0 cm., averaging 4.6 cm. The left innominate varied from 5 mm. to 18 mm. and averaged 11.7 mm. in caliber. Its length ranged from 4.5 cm. to 9.2 cm. and averaged 7.2 cm. These measurements are summarized in Table 1. A physiological area of dilatation was seen in the superior vena cava in most cases at the point where it crossed the right pulmonary artery (Fig. 1). The length of the superior vena cava and innominate veins was found to vary little

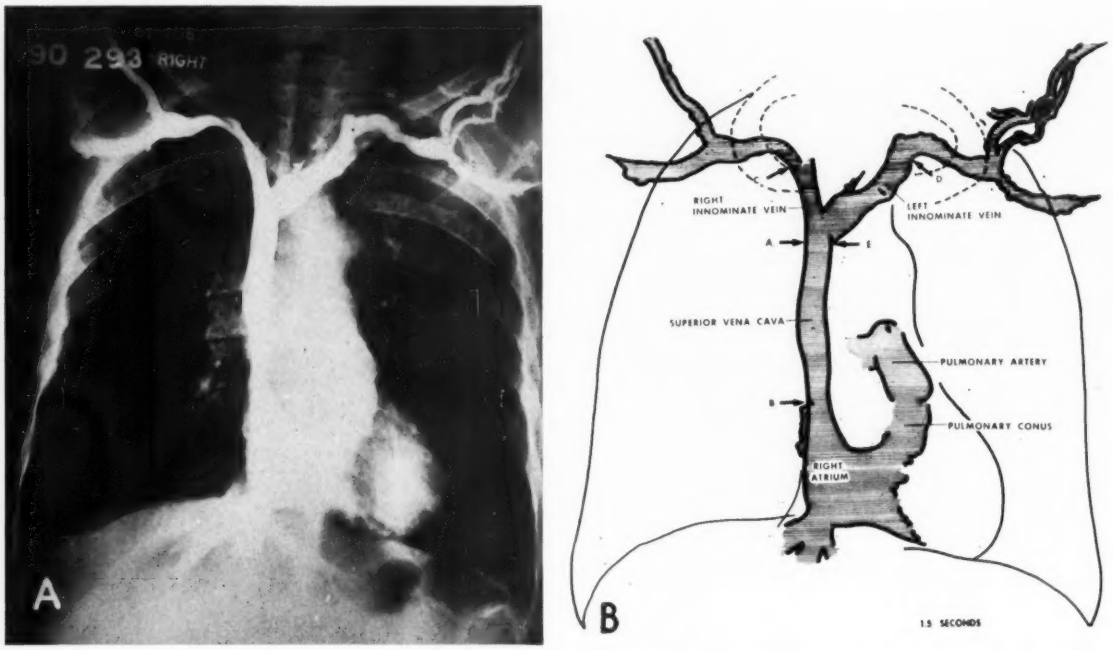

FIG. 2. *Normal Superior Vena Cava and Innominate Veins.* Frontal angiocardiogram made 1.5 seconds following bilateral injection. Male, aged forty-five (N.Y.H. 590 293). Points of measurement of length used in this study are shown on the tracing and are as follows: superior vena cava, A–B; right innominate vein, A–C; left innominate vein, E–D.

with age and sex (Fig. 3). This is in contrast to aortic length which increases significantly with advancing age.[18]

THE PATHOLOGICAL SUPERIOR VENA CAVA AND INNOMINATE VEINS

The signs and symptoms resulting from partial or total obstruction of the superior vena cava have long been recognized and referred to as the superior vena cava syndrome.[32,35,50] Many fundamentally different pathologic processes may cause the vascular obstruction. The role of angiocardiography in the study of superior vena caval abnormalities will be considered at some length under the headings of (1) congenital variations, (2) obstruction, (3) displacement and (4) dilatation.

Congenital Variations. Congenital anomalies of the superior vena cava

TABLE I

SUPERIOR VENA CAVAL MEASUREMENTS

	Length in Centimeters		Diameter in Millimeters	
	Range	Mean	Range	Mean
Superior vena cava, 151 cases. Av. age 46.6	4.2–12.0	7.7 S.D. ± 1.5	8.0–20.0	14.8 S.D. ± 2.8
Right innominate vein, 85 cases. Av. age 45.7	2.0– 7.0	4.6	5.0–17.0	9.5
Left innominate vein, 66 cases. Av. age 48.0	4.5– 9.2	7.2	5.0–18.0	11.7

and innominate veins are not uncommon.[27,30,33,37,39,43,44,49,53] In situs inversus a mirror image of the veins exists. In the absence of situs inversus, although often associated with dextrocardia, the left innominate vein may drain into the right atrium through a persistent left superior vena cava. The right innominate vein in such cases may enter the left superior vena cava or it may reach the right atrium independently by way of a right superior vena cava (double superior vena cava). In a patient with cyanotic congenital heart disease a right superior vena cava was demonstrated at angiocardiography. At subsequent cardiac catheterization, the catheter was passed down the right superior vena caval route, across the right atrium, up a left superior vena cava, across a connecting vein in the superior mediastinum and again down the right side (Fig. 4). If during angiocardiography on congenital cardiac patients a left arm vein is used for the injection, few instances of left superior vena cava will escape detection. In one instance, studied angiocardiographically, a left innominate vein (or left superior vena cava) passed beneath the aortic arch and left pulmonary artery, then crossed the superior mediastinum to enter a normally placed right superior vena cava (Fig. 5). The presence of a right aortic arch may result in lateral displacement of the superior vena cava and innominate veins.

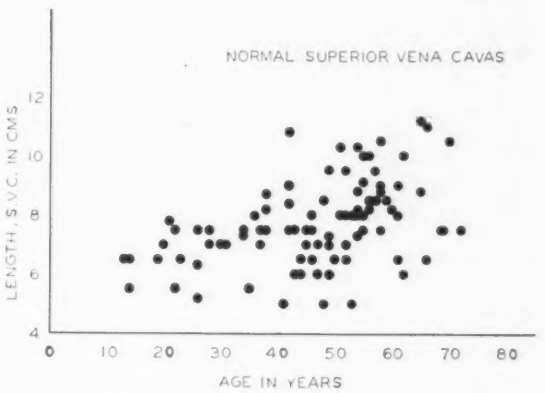

Fig. 3. *Length of Normal Superior Vena Cava.* Measurements, made as indicated in Figure 3 on 126 cases, are plotted against age.

Anomalous pulmonary veins may empty

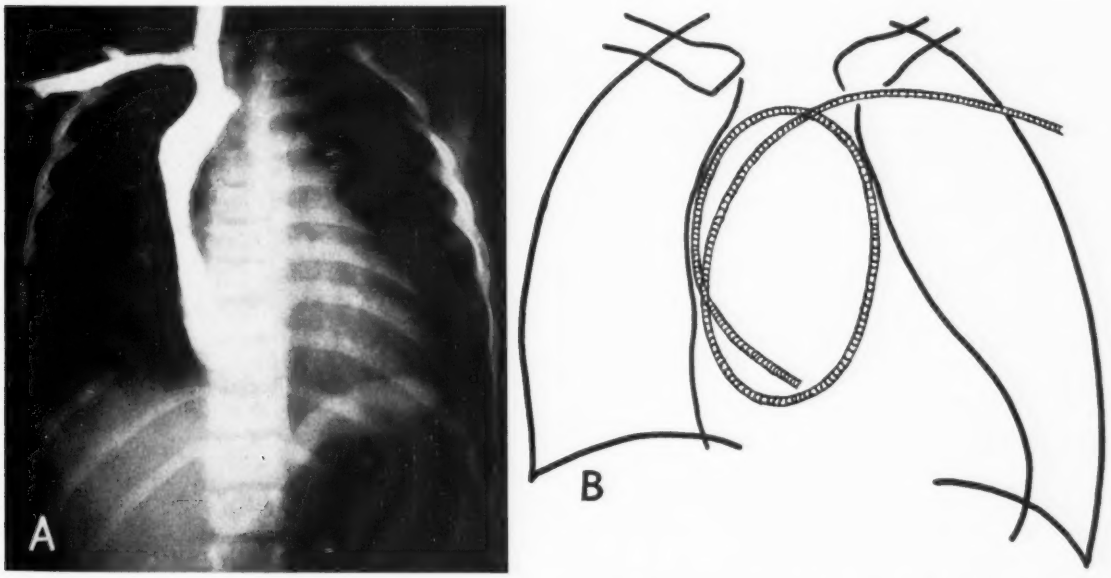

Fig. 4. *Double Superior Vena Cava.* Four year old male (N.Y.H. 517 038) with congenital tricuspid atresia and interatrial septal defect. (*A*) Frontal angiocardiogram at 1 second. The injection, made in the right arm, results in filling of a right-sided superior vena cava. (*B*) Tracing of spot film made during cardiac catheterization. The catheter passes from the left arm down the right superior vena cava, traverses the right atrium and a left superior vena cava, then once again goes down the right superior vena cava to the right atrium.

into left or right superior vena cavae, causing dilatation by virtue of increased blood flow. Abbott[2] has described a presumably congenital aneurysmal dilatation of the superior vena cava. Congenital cardiovascular anomalies such as tricuspid atresia and pulmonary stenosis with patent foramen ovale are associated with elevation of right atrial and thus superior vena caval pressure and therefore cause dynamic dilatation of both structures.

Obstruction. Due to the ease with which superior vena caval or innominate vein obstruction is recognized by clinical means, the subject has received extensive consideration in scientific publications.[3,5–9,11–15,22,23,24,26,29,31,38,40,42,45,48] Many workers have stressed and illustrated the value of contrast visualization techniques.[1,17,19,36,51,52] Since for the most part these studies were undertaken because clinical evidence pointed toward a block, and since fairly extensive obstruction may exist without producing clinical symptoms, the majority of reported venographic studies are concerned with complete or nearly total obstruction. In an extensive angiocardiographic study of mediastinal and pulmonary tumors, we have observed many cases of partial superior vena caval obstruction which would otherwise have escaped recognition.

Angiocardiography in the presence of suspected block of the superior vena cava or its tributaries should be carefully planned. If it is desired to visualize the obstruction, dilute contrast substance (35 to 50 per cent diodrast, neo-iopax or urokon sodium) is preferable to the highly concentrated solutions usually employed, and the injected volume need not be as great as in routine angiocardiography. Exposure should be made at one or two seconds following the beginning of injection. If block is complete, timing is not critical, nor is rapidity of injection. It is to be emphasized that the solutions used for contrast vascular visualization often cause local thrombosis of the vessel injected and that the symptoms of block may be aggravated by extension of the thrombosis thus caused. Patients with serious venous ob-

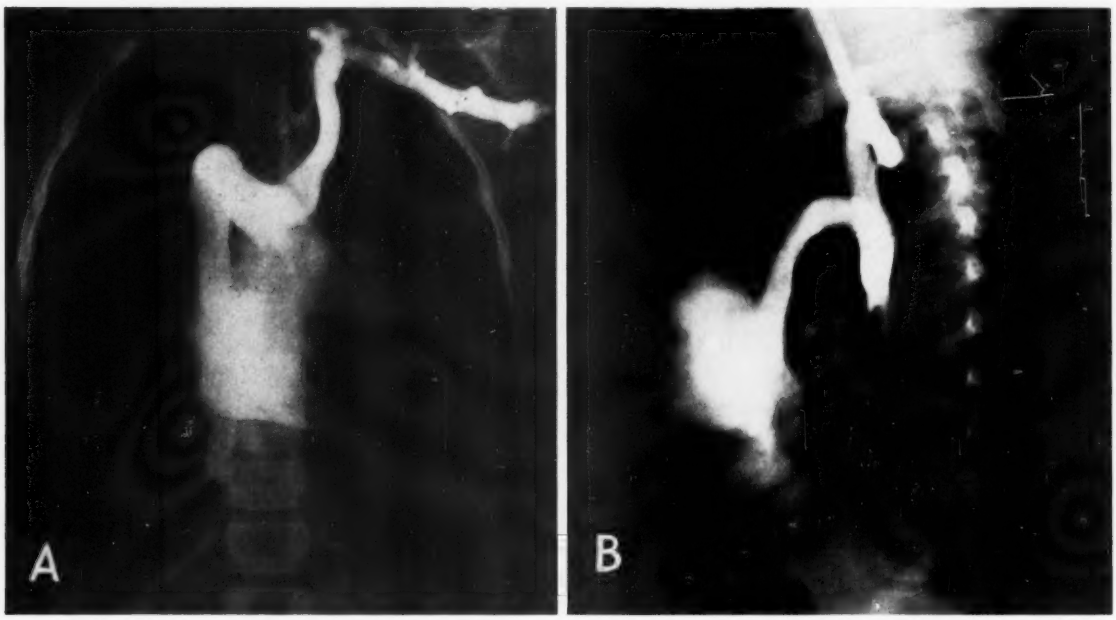

FIG. 5. *Anomalous Course of Left Innominate Vein.* Asymptomatic seven year old female (N.Y.H. 576 096). Frontal (*A*) and lateral (*B*) angiocardiograms at 1.5 seconds. The left innominate vein passes beneath the aortic arch before reaching the right superior vena cava.

struction frequently experience relatively mild immediate subjective reactions to angiocardiography since the contrast agent reaches the peripheral circulation slowly and is greatly diluted in the process.

It is imperative that the purpose of angiocardiography be defined in planning the method of study. If, for example, an innominate artery aneurysm has caused blockage of the right innominate vein, injection in the right arm veins will reveal the block but probably not the aneurysm. Conversely, injection of the left arm veins will demonstrate the aneurysm (in properly timed films) but will not demonstrate the block. If clinical methods allow the localization of the obstruction, the latter choice of technique may be preferable. In suspected pulmonary tumors associated with complete superior vena caval block it is often desirable to view the pulmonary arteries.[20] For this purpose, an injection made through the saphenous vein will suffice but will not reveal the superior vena cava.

Obstruction of the superior vena cava and its tributaries may be the result of a variety of intrathoracic abnormalities. Chief among these is neoplasm. McIntire and Sykes[41] found primary malignant thoracic tumors responsible for 33.3 per cent of 502 cases of superior vena caval obstruction. Hussey, Katz and Yater[32] reported a series of 35 cases of obstruction where neoplasms (primary and metastasis) were present in about 43 per cent. We have studied 55 cases of partial or complete superior vena caval or innominate vein obstruction (Table II); 43 cases, or 78 per cent of the total were due to tumor (Fig. 6 and 7). Although such obstruction often signifies the presence of mediastinal metastases and therefore inoperability, it may be the result of benign tumors (particularly goiter, which was responsible for 9 of our cases).

Occasionally it is possible to demonstrate changes in the obstructed vessel which in themselves strongly indicate actual in-

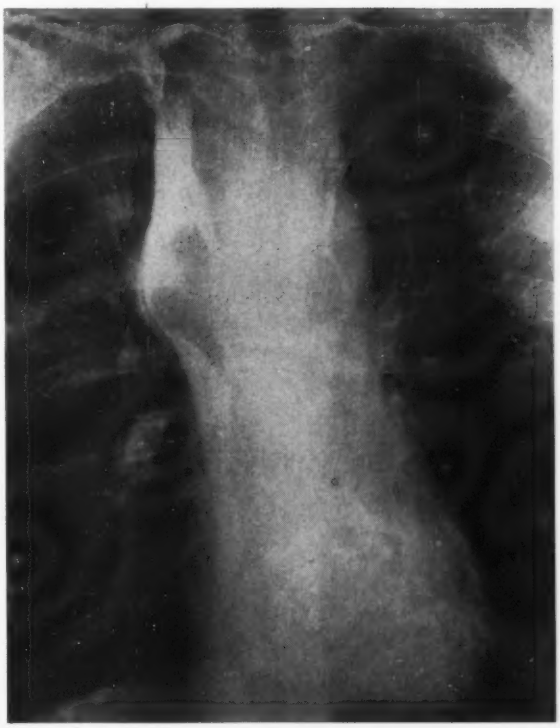

Fig. 6. *Invasion of Superior Vena Cava by Tumor.* Forty-four year old male (N.Y.H. 517 945) with cough, edema of the neck and recurrent syncope for five weeks. Frontal angiocardiogram at 3 seconds. There is virtually complete obstruction of the superior vena cava at or below the site of junction of the innominate veins. The ragged filling defect suggests the presence of an invasive tumor.

Table II

DISEASES PRODUCING OBSTRUCTION OF SUPERIOR VENA CAVAL SYSTEM

Cause of Obstruction	Number of Cases	
Tumor	44	
Bronchogenic carcinoma		17
Mediastinal tumor (type unspecified)		17
Retrosternal thyroid		5
Thyroid carcinoma		2
Metastatic carcinoma (kidney)		1
Malignant thymoma		1
Hodgkin's lymphoma		1
Syphilitic Aneurysm	8	
Aortic		7
Innominate		1
Thrombosis	3	
TOTAL	55	

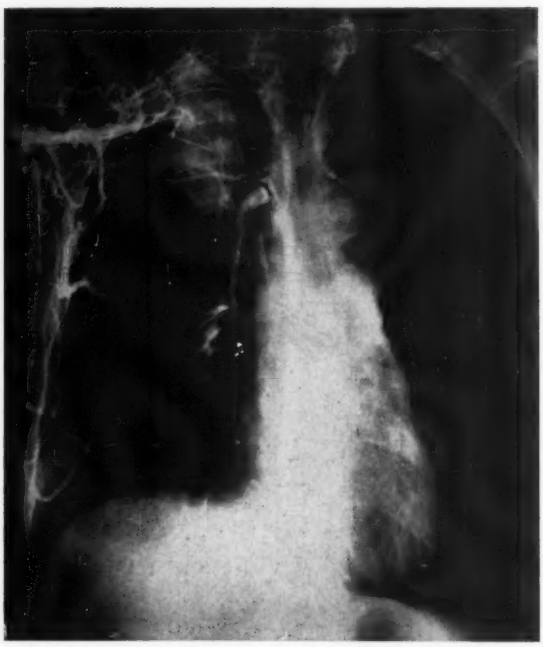

FIG. 7. *Right Innominate Vein Obstruction Due to Tumor.* Fifty-six year old female (N.Y.H. 530 767) with superior vena caval syndrome, cough, weight loss and chest pain. There is total obstruction of the right innominate vein shown on frontal angiocardiogram made 4.0 seconds after the injection. There is filling of extensive collateral channels involving intercostal, lateral thoracic and internal mammary veins on the right as well as venous channels in the neck. Thoracotomy disclosed inoperable carcinoma of the lung.

vasion of the vessel by tumor tissue. At least two polypoid filling defects in the superior vena cava have been observed where the defect could be shown clearly in films made in two projections at right angles to each other. Biplane study is necessary to distinguish with certainty between polypoid intraluminal growth and filling defects resulting from localized areas of extrinsic pressure. The diagnosis of malignant invasion or stenosis of veins should be made with great caution.

Obstructions of widely varying degree may be caused by syphilitic aneurysms of the aorta or innominate arteries (responsible for 15 per cent of our 55 cases of block). Displacement invariably precedes and usually predominates over obstruction in such cases, however (Fig. 8). Occasionally, rupture with the production of an arteriovenous aneurysm results.[4] Idiopathic thrombosis may cause superior mediastinal venous obstruction. Superior vena caval block due to thrombosis associated with mediastinitis is usually complete. Where high-grade block has existed for a long time the development of collateral circulation has been most marked (Fig. 9). In a case of superior vena caval block probably due to trauma, reported elsewhere,[21] angiocardiographic examinations were performed eleven years apart. No significant interval change was demonstrated. Obstruction may be the result of non-neoplastic enlargement of mediastinal lymph nodes, as in tuberculosis or Boeck's sarcoid. Slight rather than high degrees of narrowing are usual.

Regardless of the cause of obstruction,

FIG. 8. *Superior Vena Caval Displacement by Innominate Artery Aneurysm.* Fifty-six year old male (N.Y.H. 585 983). Frontal angiocardiogram at 2.0 seconds. The superior vena cava and right innominate vein are displaced laterally and are narrowed by an aneurysm of the innominate artery which was shown on the left heart angiocardiogram.

it is well shown angiocardiographically as are the collateral channels which develop as a result. Experimental studies by Carlson[10] and the thorough discussion by McIntire and Sykes[41] constitute valuable sources of reference for the identification of these collateral pathways. In our experience, most superior vena caval blocks have occurred above the level of the azygos vein, the azygos, internal mammary, intercostal and lateral thoracic veins playing important roles in the collateral circulation (Fig. 7). Where block involves an innominate vein, a dense plexus of cervical and thyroid veins connecting with the opposite side are usually demonstrated. Dilatation of the veins peripheral to the site of a block is usually demonstrable.

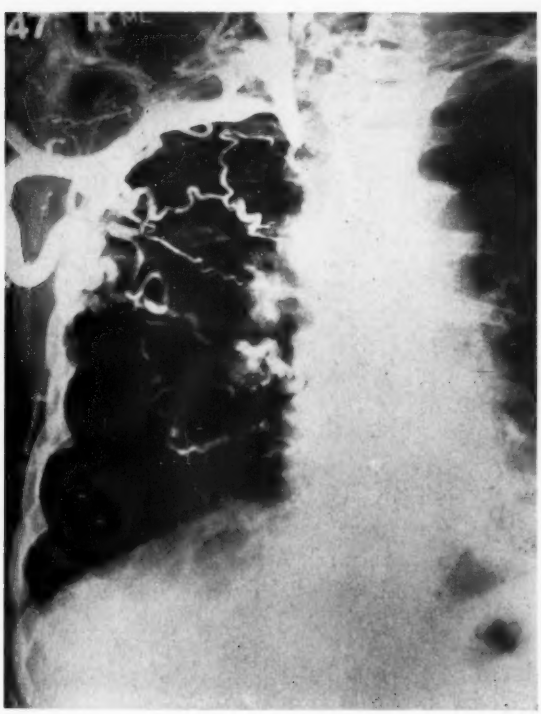

Fig. 9. *Right Innominate Vein Thrombosis Secondary to Mediastinitis.* Fifty-three year old female (N.Y.H. 501 047) who had had symptoms of superior vena caval obstruction for many years. Frontal angiocardiogram at 5.0 seconds. There is complete block of the right innominate vein with the demonstration of extensive collateral pathways including the intercostal, lateral thoracic and internal mammary routes but not the azygos. Subsequent examination demonstrated block of the left innominate vein.

Fig. 10. *Displacement and Distortion of the Superior Vena Cava Following Pneumonectomy.* Fifty-seven year old male (N.Y.H. 522 880) who had a right pneumonectomy for carcinoma of the lung two years before. There is shift of the heart and mediastinal structures to the right. The left innominate vein is markedly elongated and the superior vena cava is displaced and distorted.

Displacement. Displacement and distortion of the superior vena cava and the innominate veins with or without obstruction is extremely common. Mediastinal tumors, syphilitic aortitis and aortic aneurysms (Fig. 8) may greatly elongate and distort the thin-walled veins. The fact that displacement without stenosis is caused by a tumor does not indicate that the lesion is benign, although malignant lesions are more prone to cause occlusion. With arteriosclerotic, hypertensive or syphilitic aortic elongation and dilatation, the superior vena cava is often pushed to the right in a smooth curve. The aorta often partially overlaps the superior vena cava in such instances. Enlargement of the thyroid gland may displace the innominate veins as may arteriosclerotic buckling of the brachiocephalic arteries.

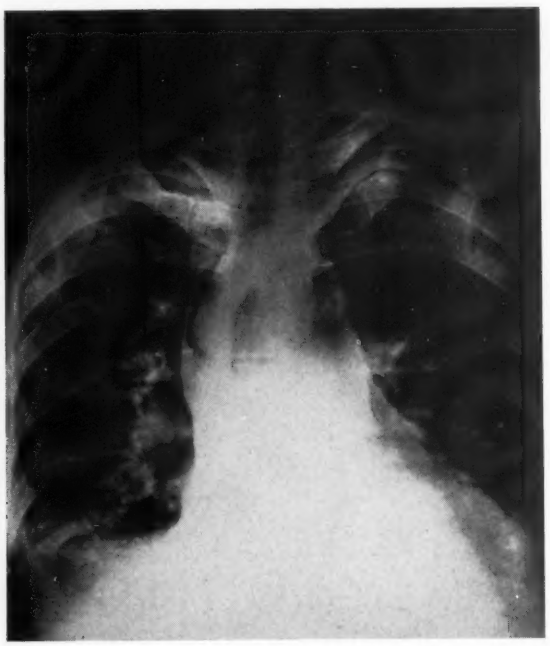

FIG. 11. *Dilatation of Superior Vena Cava Due to Heart Failure.* Sixty-one year old male (N.Y.H. 456 001) with arteriosclerotic heart disease and congestive failure. Frontal angiocardiogram at 2.5 seconds. The superior vena cava and left innominate vein are dilated. The venous pressure was 150 mm. of saline.

Operative procedures performed upon the thorax and its contents often result in striking distortion of the superior vena cava. Thoracoplasty, pneumothorax and pneumonectomy (Fig. 10) may be mentioned in this connection. Emphysema causes a lowering of the diaphragms and elongation of the superior vena cava; pneumoperitoneum and phrenic nerve crush produce an opposite effect. The superior vena cava moves freely with the mediastinum and therefore is displaced toward the side of atelectasis or "fibrothorax" and away from the side of massive pleural effusions. In general, the demonstration of superior vena caval displacement resulting from conditions other than tumor is of primarily academic interest.

Dilatation. Superior vena caval dilatation is the result of increased intraluminal pressure as has been demonstrated by studies of the venous pressure in the arms. Cardiac catheterization studies indicate that mean pressure in the superior vena cava, normally ranging up to 5 mm. Hg (68 mm. of saline), increases greatly with cardiac failure; levels of 15 mm. Hg. (204 mm. of saline) are not uncommon. Pressure in the innominate veins or the superior vena cava proximal to a mechanical block may reach heights of 30 mm. Hg. (408 mm. of saline). The degree of dilatation is not always directly related to the pressure; other factors such as the duration of hypertension, the character of the vascular walls and surrounding tissues being significant factors. Catheterization studies indicate that little elevation of central venous pressure results from angiocardiographic injection.

Congestive or right-sided heart failure, regardless of its etiology, is usually manifested by appreciable dilatation of the superior vena caval system (Fig. 11). The accumulation of pericardial effusion and,

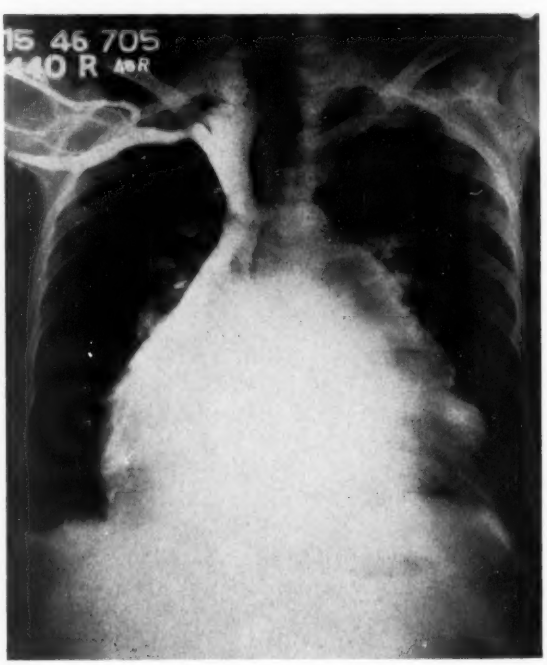

FIG. 12. *Dilatation of Superior Vena Cava Due to Tricuspid Insufficiency.* Thirty-eight year old female (N.Y.H. 455 440) with rheumatic heart disease. Presence of tricuspid insufficiency established at cardiac catheterization. Frontal angiocardiogram at 3.0 seconds. There is marked enlargement of the right atrium and dilatation of the superior vena cava, characteristic findings in tricuspid valvular disease.

in a similar manner, the presence of constrictive pericarditis usually produces such dilatation, probably as the result of limited diastolic volume of the right ventricle. The superior vena caval and peripheral venous dilatation in constrictive pericarditis is certainly not the result of constriction of the superior and inferior vena cavae as they enter the pericardium. As mentioned, certain congenital cardiac anomalies cause elevation of the right atrial pressure in the absence of heart failure and therefore may cause superior vena caval dilatation. Notable among these lesions are tricuspid stenosis or atresia and the combination of pulmonary stenosis and patent foramen ovale with reversal of flow through the septal defect. Anomalous pulmonary veins emptying into the superior vena cava cause a marked enlargement of that vessel due to the increased, resultant blood flow. Tricuspid insufficiency transmits right ventricular pressure to the right atrium and its tributaries and usually causes striking enlargement of these structures (Fig. 12). External pressure on the easily distorted superior vena cava may cause flattening and thus broadening of the opacified shadows of these vessels. This can best be distinguished from true dilatation by study of the vessel in two projections.

SUMMARY

Measurements of length and caliber of the normal superior vena cava were made by means of angiocardiography. Abnormalities of the superior vena caval system are described in terms of the changes produced. Congenital anomalies, occlusion, displacement and dilatation are individually discussed. In a series of 55 cases showing obstruction of these veins, 78 per cent were found to be the result of tumors, 15 per cent the result of aneurysm and the remainder due to mediastinitis, thrombosis and other causes. The nature of displacement and occlusion of the superior vena cava and innominate veins, studied angiocardiographically, often provides diagnostic information regarding the fundamental abnormality present. Dilatation of the superior vena cava is the result of increased pressure or flow within the vessel, heart failure being a principal cause of the former.

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THE NORMALLY SITUATED ARCH OF THE AZYGOS VEIN: ITS ROENTGENOLOGIC IDENTIFICATION AND CATHETERIZATION*†

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THE image of the arch of the azygos vein projected on end is visible in a considerable percentage of posteroanterior chest roentgenograms of normal individuals. In the right anterior oblique view with the patient supine during visualization of the esophagus, the image of the arch of the vein can also frequently be recognized. It is prominent and almost constant in the anteroposterior planar roentgenograms through the level of the bifurcation of the trachea made with the patient supine. Unless one is familiar with the roentgenologic image of the normally situated arch of the azygos vein it is very apt to be interpreted as an enlarged lymph node, particularly in the planar roentgenogram, and may be considered to be of some pathologic significance. The image of the arch of the azygos vein should be recognized as one of the anatomical landmarks in the roentgenology of the chest.

REVIEW OF LITERATURE

Despite the frequency with which the arch of the azygos vein can be recognized in roentgenograms and roentgenoscopically, descriptions of its roentgen appearance have received scant attention in the roentgen literature in the United States. A. W. Crane[2] appears to have been the first to describe in detail the image of the normal azygos vein as seen in chest roentgenograms. His paper entitled "The Inverted Comma Sign in Pulmonary Roentgenology" appeared in 1918, and he had previously presented the subject at a meeting of the Chicago Medical Society in 1914. In an analysis of 300 consecutive chest roentgenograms of patients with assorted disorders, he estimated that 20 per cent showed this inverted comma sign, an ovoid density lying in the angle along the right border of the trachea and right main bronchus. Crane commented that the density did not have the appearance of an ordinary lymph node and that it was definitely not a hilar lymph node. However, due to the high incidence of tuberculosis in his cases in association with this image, he came to the conclusion that it was a sign of tuberculosis. Nevertheless, Crane stated, "No other bronchial gland and no bronchial adenopathy ever give a similar roentgenologic appearance." He mentioned several autopsy studies, in some of which enlarged lymph nodes were found in this area while in others nothing at all was found. In no instance was the connection between the inverted comma sign and the arch of the azygos vein realized. In 1931, two reports appeared independently, ascribing the small ovoid soft tissue density along the lateral border of the origin of the right main bronchus to the azygos vein. The reports of Ottonello,[11,12] working under Busi in Rome, appear to have stimulated most of the later European and South American writings on the roentgenology of the azygos vein. Ottonello presented the case very clearly for ascribing the inverted comma sign of Crane to the arch of the azygos vein. Mowat[10] in England presented illustrations of the image of the vein as seen in the right anterior oblique view. Mowat suggested the possibility that enlargement of the azygos vein might provide an early

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sign of portal venous stasis. Le Bourdelles *et al.*[9] emphasized the importance of the image of the arch of the vein to the phthisiologist because of the tendency to confuse this shadow with that of tracheobronchial adenopathy. These authors also pointed out that its presence in the roentgenogram in the normal position excludes the presence of an azygos lobe or fissure

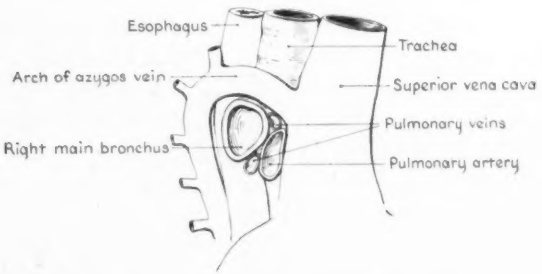

FIG. 1. Diagram of the arch of the azygos vein and its relations viewed from the right (after Testut).

when confusion arises due to fibrotic or other densities simulating these anomalous structures. Trepiccioni[14] described the variations in size during respiration with increasing size in inspiration and thinning during forced expiration or performance of the Valsalva experiment; this author suggested investigation of the variation in size of the image of the arch of the vein in disturbances of the inferior vena cava and of the right heart. Grilli[6] described enlargement of the azygos vein shadow as seen in the right anterior oblique view in 6 cases of portal stasis with esophageal varices. Durieu and Lequime[3] described enlargement of the azygos vein shadow in the frontal view in patients with cardiac failure and stasis in the lesser circulation; accentuation of the image was found with elevated venous pressure. Henningsen[7] emphasized the importance of the azygos vein in the tomographic diagnosis of tuberculosis of the hilus; he mentioned several authors whom he felt had referred to the image of the vein in planar roentgenograms as evidence of an enlarged bronchial lymph node. Roesler[13] described the arch of the azygos vein and mentions its variations during the phases of respiration and its enlargement in right heart failure. More recently Joselevich and Mactas[8] reported a high incidence of an enlarged azygos vein shadow in cases of cardiac insufficiency. Gemignani[4] has also commented on the enlargement of the azygos vein shadow in cardiac decompensation and on its prominence in the planar roentgenogram of the lung roots. Gladnikoff[5] recognized the azygos arch image in roentgenograms of 3 of 15 normal individuals examined and he stresses the importance of differentiating this soft tissue bulge from an enlarged lymph node. Burke and Goldberg[1] illustrate the azygos arch image in planar roentgenograms.

ANATOMICAL CONSIDERATIONS

The azygos vein arises in the abdomen as the right ascending lumbar vein, and through this has linkage with various tributaries of the inferior vena cava so that

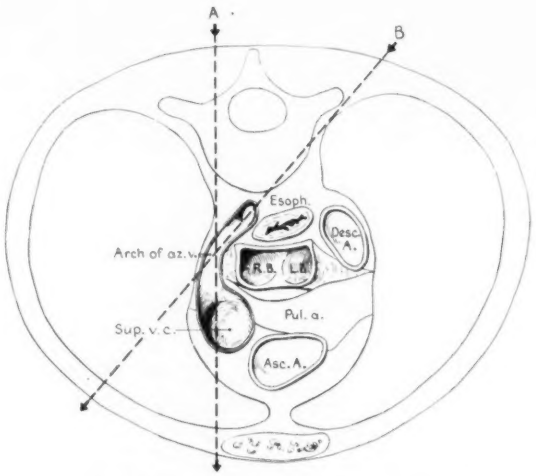

FIG. 2. Diagram of cross section of the thorax at the level of the axygos vein arch (after Mowat). *A* and *B* show the portions of the azygos arch intersected by paths of rays in the posteroanterior and right anterior oblique projections, respectively.

in blockage of the inferior vena cava the azygos may become an important mode of venous return to the heart. The azygos vein ascends along the right side of the anterior surfaces of the thoracic vertebral

bodies to the level of the fourth or fifth vertebra and then it courses anteriorly over the root of the right lung and over the angle between the trachea and the right main stem bronchus to enter the superior vena cava. Figure 1 shows diagrammatically the relationship in parasagittal section at the level of the horizontal, terminal portion of the azygos vein as it enters the superior vena cava. Figure 2 shows diagrammatically a cross section at the level of the arch of the azygos vein, the arrows indicating how in posteroanterior and right anterior oblique projections portions of the azygos arch lie parallel to the roentgen-ray beam so as to cast a dense, well defined roentgen shadow.

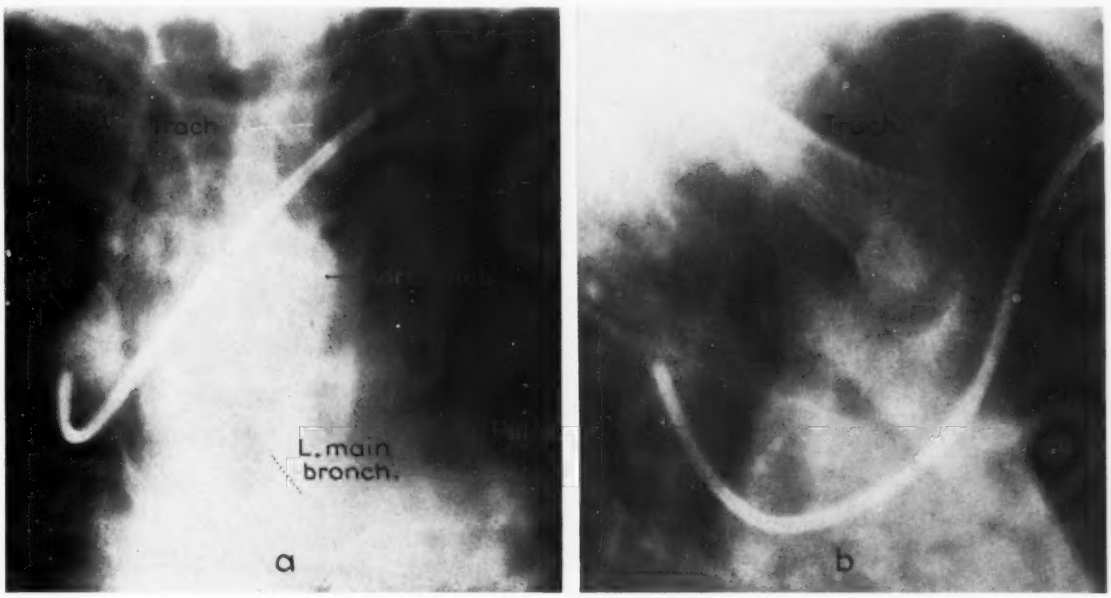

Fig. 3. Catheter inserted into the arch of the azygos vein during right heart catheterization. (*a*) Frontal view. (*b*) Right anterior oblique view.

CATHETERIZATION

We have found it possible to catheterize the horizontal portion of the azygos vein with relative ease during right heart catheterization. In the successful attempts the most satisfactory position of the patient was found to be the right anterior oblique view which provided roentgenoscopic visualization of the image of the azygos arch as it crosses the right main bronchus; with the catheter in the superior vena cava, the tip was directed posteriorly toward this image of the vein. During the manipulation the tip of the catheter could be seen frequently to catch on what was assumed to be the mouth of the vein and slip past it into the lower superior vena cava and right atrium. However, it was usually possible by manipulation to pass the tip of the catheter into the mouth of the vein and well into its transverse portion. Attempts to introduce the catheter farther resulted in the catheter doubling upon itself and the tip then slipped back into the superior vena cava. In Figure 3 spot films, made during this procedure, are reproduced showing the catheter lying in the superior vena cava and entering the arch of the azygos vein.

Catheterization of the azygos vein provides additional proof that the image of Crane and of Ottonello represents the normally situated azygos arch. It is conceivable that the procedure may prove applicable in studies of portal hypertension; for instance, opacification of the tributaries

of the azygos vein might be accomplished by retrograde injection.

ROENTGEN IDENTIFICATION

Posteroanterior Projection. The image of the azygos vein arch as visualized in the posteroanterior projection has received a variety of descriptive names. It has been likened to a note of music, to an inverted comma, etc. It is ovoid and tapers at its upper extremity to blend with the linear shadow of the tracheal wall. The lower tip of the shadow may be bulbous or may taper off along the wall of the right main bronchus. Visualization is affected by a number of factors including the roentgenographic technique; of great importance is the exact angle of projection of the rays; well penetrated films show it to best advantage. The shadow is often obscured when it overlies the spine, and very slight rotation into the left anterior oblique position will tend to throw the shadow free of the spine so that it is more readily visualized. Any pathologic process which causes increased density in the region of the upper mediastinum will tend to obscure the shadow. The vein image is ordinarily considerably more prominent due to engorgement when the chest film is made with the patient prone or supine and it can be definitely increased in size in the horizontal position by having the patient attempt inspiration with the glottis closed (Müller maneuver) which causes a marked decrease in intrathoracic pressure and tends to suck blood into the large thoracic veins. In the upright position the vein tends to empty out and is apt to be collapsed. Performance of the Valsalva maneuver of forced expiration with the glottis closed following a deep inspiration will cause a very marked decrease in the size of the vein (Fig. 5). This undoubtedly provides one very important explanation for the absence of the shadow of the vein in

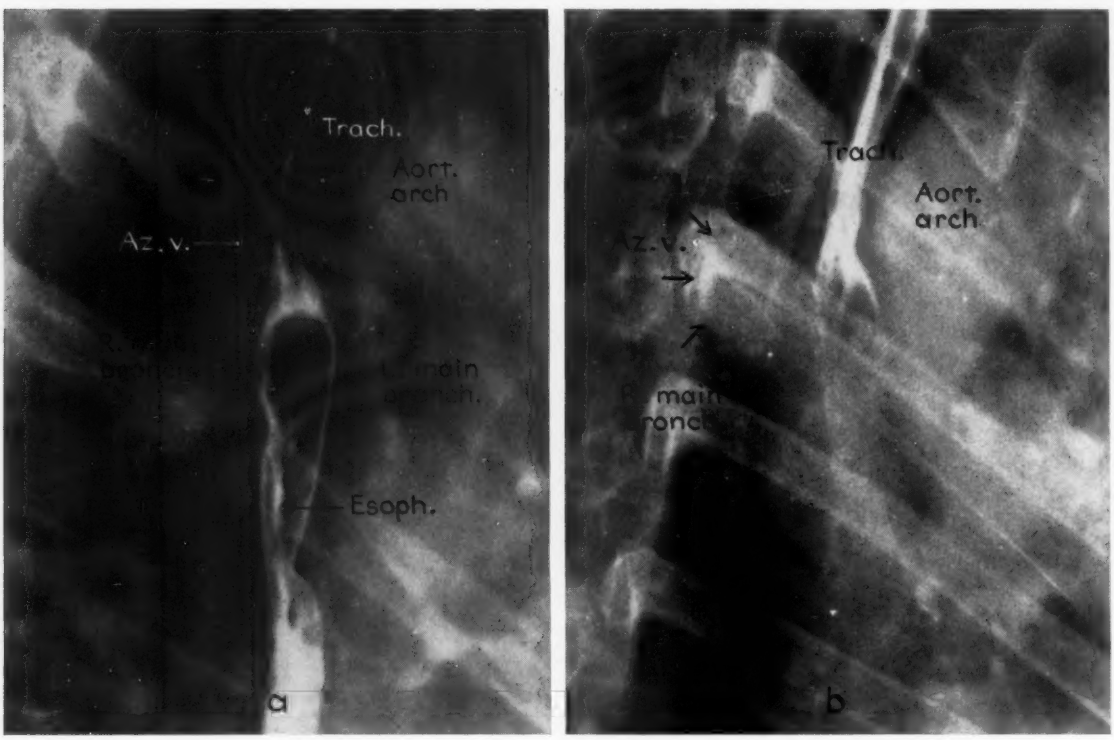

FIG. 4. Image of azygos arch in the right anterior oblique view. (*a*) In inspiration with Valsalva maneuver. (*b*) Expiration. Marked increase in size of vein.

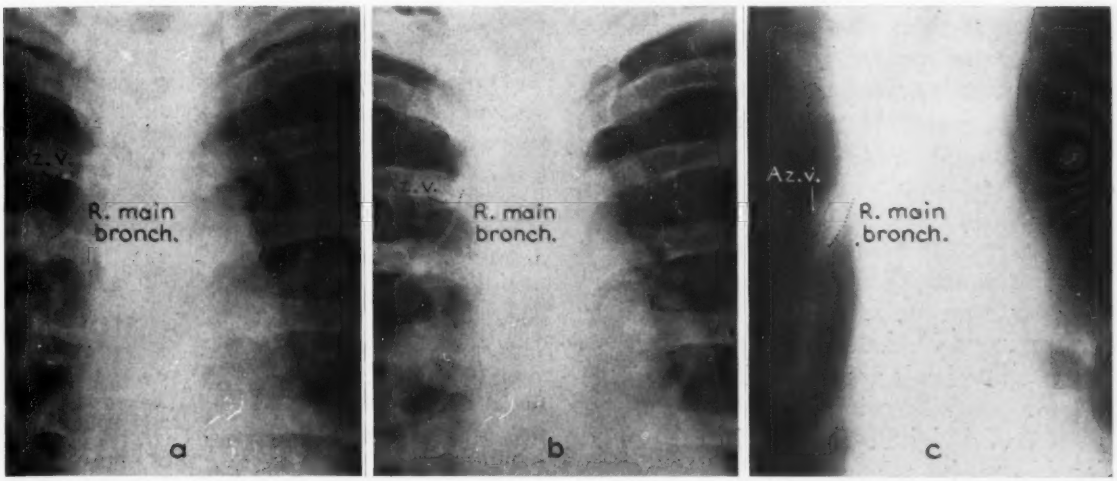

Fig. 5. Azygos vein shadow simulating enlarged lymph node in a case of Hodgkin's disease. (*a*) Upright posteroanterior chest film. (*b*) Upright posteroanterior film, Valsalva maneuver. Decrease in size of azygos image. (*c*) Planar roentgenogram, supine. Azygos vein distended.

very many routine upright chest roentgenograms since it is well known that the Valsalva maneuver is commonly performed unintentionally by patients when they are told to take a deep breath and hold it during the making of the roentgen exposure.

Estimates of the frequency of visualization of the azygos vein in the usual chest roentgenogram have varied widely in the literature; for normal adults Joselevich and Mactas[8] collected figures ranging from 3.5 per cent to 49.6 per cent. In reading routine photofluorograms of out-patients, hospital admissions, and students, a member of the Department of Radiology (C.M.N.) found the azygos vein image in 70 of 1,121 consecutive cases (6.2 per cent).

Planar Roentgenogram. In the planar roentgenogram at the level of the tracheal bifurcation, the image of the azygos arch is essentially the same in general contour as noted in the upright view except that it is ordinarily much better visualized and is

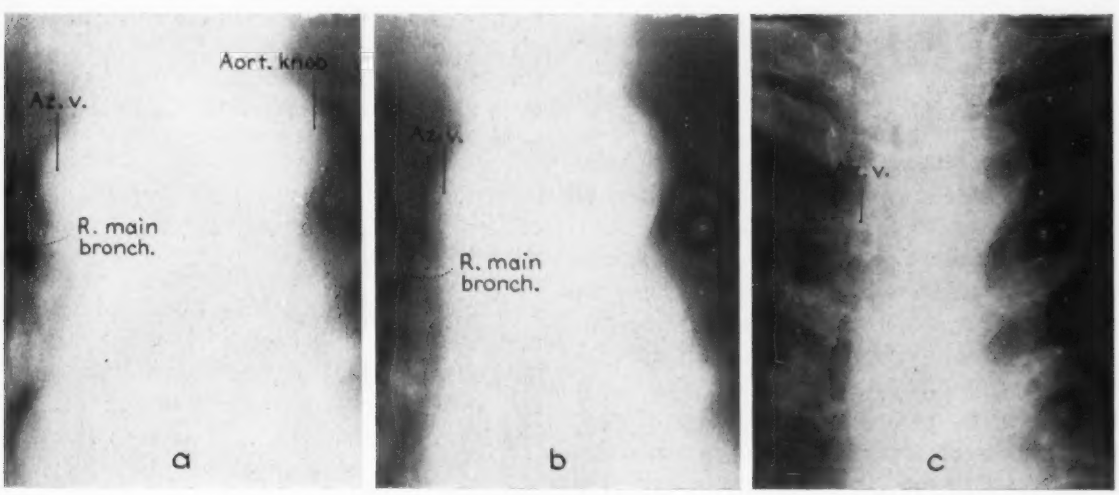

Fig. 6. Large azygos vein arch in a case of obstructed inferior vena cava. (*a*) Supine planar roentgenogram, inspiration. (*b*) Supine planar roentgenogram, inspiration with Valsalva maneuver. Azygos vein smaller. (*c*) Upright posteroanterior chest film; arch of azygos vein collapsed.

much larger than as visualized in the upright routine posteroanterior chest film. Here again, performance of a Valsalva maneuver, despite the fact that the patient is supine, will ordinarily cause a very definite and observable flattening of the image of the vein (Fig. 6). This is an important phenomenon and can be utilized to distinguish the normal azygos vein shadow from enlarged lymph nodes or other masses in the same region. A group of lymph nodes is normally situated in the angle formed by the lateral walls of the trachea and right bronchus, in close relationship to the azygos vein.

Right Anterior Oblique View. We have very frequently been able to observe the shadow of the azygos vein arch in the right anterior oblique view, as described originally by Mowat, particularly in connection with roentgenoscopic visualization of the esophagus. The image is equally well visualized in the right anterior oblique view with the patient supine or in the equivalent left posterior oblique view with the patient face down. The latter has been the more frequent position for study since it is convenient for visualization of the esophagus. Mowat described and illustrated a small indentation upon the esophagus, apparently produced by the adjacent azygos vein, but we have not observed this finding. Figure 4 illustrates the image of the vein showing its enlargement during expiration and the flattening of the shadow during performance of the Valsalva maneuver. The reproductions are from spot films made at the time of roentgenoscopy.

Observations in Clinical Cases. A recently encountered case is of interest to emphasize the importance of roentgenologic identification of this shadow.

A student nurse, when studied two years prior to the recent roentgen examination, showed a right upper mediastinal mass, and a diagnosis of Hodgkin's disease was made on the basis of biopsy of a peripheral lymph node. The right upper mediastinal mass regressed completely following radiation therapy. When the patient returned recently complaining of an annoying cough, the small shadow above the right main stem bronchus shown in Figure *5a* was noted. Initially this was believed to represent an enlarged bronchial lymph node and probably recurrent Hodgkin's disease. However, planar roentgenography, as shown in Figure *5c*, demonstrated clearly that this soft tissue shadow was that of the azygos vein and, as shown in Figure *5b* in the upright position during performance of the Valsalva maneuver, the shadow became considerably smaller.

The largest images of the azygos vein arch which we have observed have been in 2 cases with occlusion of the inferior vena cava.

In the first of these, illustrated in Figure 6, the patient, a man aged fifty-five, had experienced acute, severe pain in the low back after lifting a mattress four years before the present roentgen examination. A month following the episode of severe pain, swelling of his legs developed which had persisted. Venography (performed by Dr. B. J. O'Loughlin at the Veterans Hospital, Minneapolis) demonstrated occlusion of the inferior vena cava with a widespread collateral circulation. Injection with diodrast of one of the small superficial veins of the collateral circulation visible in the right flank outlined the lower intercostals flowing into the azygos vein. Opacification of the lower portion of the azygos vein was not demonstrable in the films. In the supine position however, the azygos vein arch showed a diameter equal approximately to two-thirds that of the aortic arch as visualized in the same film. The planar roentgenogram in Figure *6a* demonstrates the size of the vein as seen in inspiration. Figure *6b* shows a planar roentgenogram made at the same level, but during the performance of the Valsalva maneuver with the consequent decrease in the caliber of the azygos vein, the aorta showing relatively slight change.

The most striking thing observed in this and the following case with a very large azygos vein in the supine position has been the practically complete absence of the shadow of the azygos vein arch in the upright posteroanterior chest film. This is reproduced for the first case in Figure *6C* and it will be seen that there is little evidence of the azygos arch shadow in its normal position.

The second case of this kind was studied by one of us (H.M.S.) at Temple University Hospital. The patient, a man aged forty-one, had developed marked swelling of the lower extremities following an acute febrile illness, from the patient's story possibly scarlet fever. The swelling of the legs persisted for four years intervening prior to the performance of the roentgen

The cases presented serve to illustrate the tremendous variations in the caliber of the azygos vein between the recumbent and upright positions and with changes in the intrathoracic pressure. We have attempted to find some correlation between the size of the azygos vein and the presence

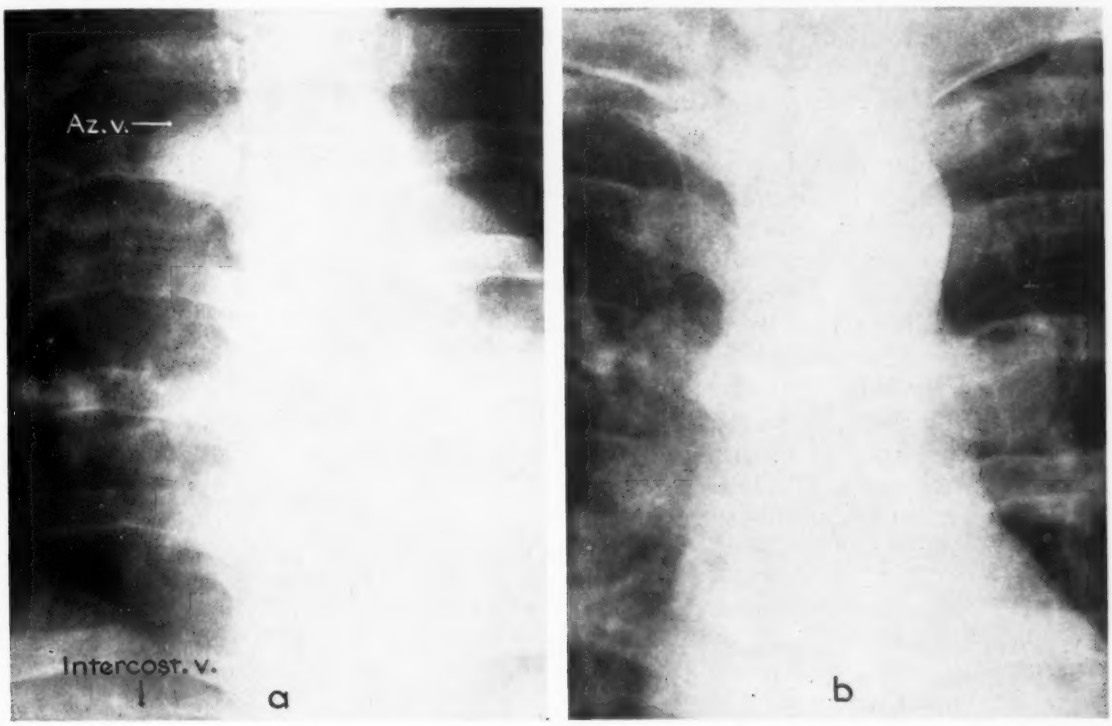

Fig. 7. Large azygos vein arch in second case with inferior vena cava obstructed. (*a*) Supine anteroposterior roentgenogram; intercostal vein opacified by diodrast injected into superficial vein in right groin. Possibly some opacification of azygos arch. (*b*) Posteroanterior upright chest film; no azygos image visible due to collapse of vein.

examination. Venograms of the legs demonstrated no filling of the femoral veins, with all of the diodrast passing upward into an abundant collateral circulation. Here again, injection of one of the superficial veins, this time in the groin on the right side, showed filling of a number of the lower right intercostal veins. A film of the thorax in the supine position during the venogram suggested some opacification of the arch of the azygos vein. Here, too, the azygos vein shadow appeared very large, approximately half the diameter of the aortic arch (Fig. 7*a*). As in the preceding case, there was practically complete collapse of the azygos vein as visualized in the upright chest film (Fig. 7*b*).

of portal stasis in a few cases, but to date equally large veins have been encountered in supposedly normal individuals. The extremely wide variation in the size of the vein with change of bodily position and with the phases of respiration makes small changes in the size of the vein extremely unreliable as a guide to the recognition of increased venous pressure or portal stasis.

In the 2 cases of inferior vena cava obstruction presented above, in which the size of the azygos vein arch was far above the usual upper limits of normal, it seems entirely probable that the increased caliber

represented accommodation of the vein to a greatly increased flow.

In 2 additional cases of vena cava obstruction in which the azygos vein was not studied particularly, there was no evidence recognizable in the posteroanterior chest roentgenograms with the patient upright, of enlargement of the azygos vein shadow. One of these cases was proved at autopsy to have obstruction of the inferior vena cava. In the other case such obstruction was demonstrated by inferior vena cavography.

We have observed enlargement of the azygos vein shadow in the presence of right heart failure but here the superior vena cava is ordinarily greatly dilated also; usually there is sufficient pulmonary congestion as well to obscure largely the azygos vein shadow and make its interpretation so doubtful that this sign is of relatively little value. Occasionally it may provide a clue roentgenologically to the presence of right heart failure which is not evident otherwise from the roentgen examination alone.

SUMMARY

1. The shadow of the arch of the azygos vein in normal position is present in a significant number of routine posteroanterior roentgenograms of the chest. It is almost uniformly present in planar roentgenograms of the bifurcation of the trachea made with the patient supine. In both instances the image of the vein should be recognized as part of the roentgen topography of the chest.

2. The size of the azygos vein decreases markedly in the upright position and during the increased intrathoracic pressure of the Valsalva maneuver. These are useful means of differentiating the normal vein shadow from that of an enlarged node or other paratracheal mass.

3. A portion of the azygos vein arch can also be visualized in the right anterior oblique view.

4. Catheterization of the azygos vein arch has been accomplished with relative ease during right heart catheterization.

5. The marked variation of the caliber of the vein with alteration of position and of intrathoracic pressure so much overshadows its changes with venous stasis or increased pressure as to make such changes of little diagnostic value.

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ROENTGENOGRAPHIC FEATURES OF SLIPPED CAPITAL FEMORAL EPIPHYSIS*

By ARMIN KLEIN, M.D., ROBERT J. JOPLIN, M.D., JOHN A. REIDY, M.D., *and* JOSEPH HANELIN, M.D.

BOSTON, MASSACHUSETTS

EARLY diagnosis of slipped capital femoral epiphysis permits early treatment; early treatment secures the best results. A "slip" may be suspected if the patient is a child, six to sixteen years of age, with a limp and/or pain in the region of the hip, anterior thigh or knee, with external rotation of the leg and limited flexion and internal rotation of the hip. The suspicion may appear well grounded on the basis of the clinical findings, but confirmation of slipping and evaluation of its severity will depend ultimately upon the roentgen examination.

The amount of slipping shown on the the roentgenograms determines the type of treatment; if it is minimal, nailing in situ is widely accepted as the treatment. This procedure is readily available to the surgeon who can nail fractured hips. If, on the other hand, slipping is marked, open reduction becomes necessary. This entails osteotomy through the epiphyseal plate and anatomic replacement of the head before nailing, a relatively difficult procedure even for the well trained orthopedic surgeon.

Ideally, therefore, the diagnosis should be made as soon as possible. The ability to establish an early diagnosis presupposes an appreciation of the slightest variations from normal. Without roentgenograms of "normals" readily accessible for comparison it is sometimes difficult, or even impossible, to determine whether minimal slipping is demonstrated.

In order to demonstrate the relationship of the femoral head and neck in the growing child, a series of "normal" hip roentgenograms from birth to maturity (Fig. 1 and 2) have been assembled.† These serve as standards for comparison if standardized roentgenologic technique is always used.

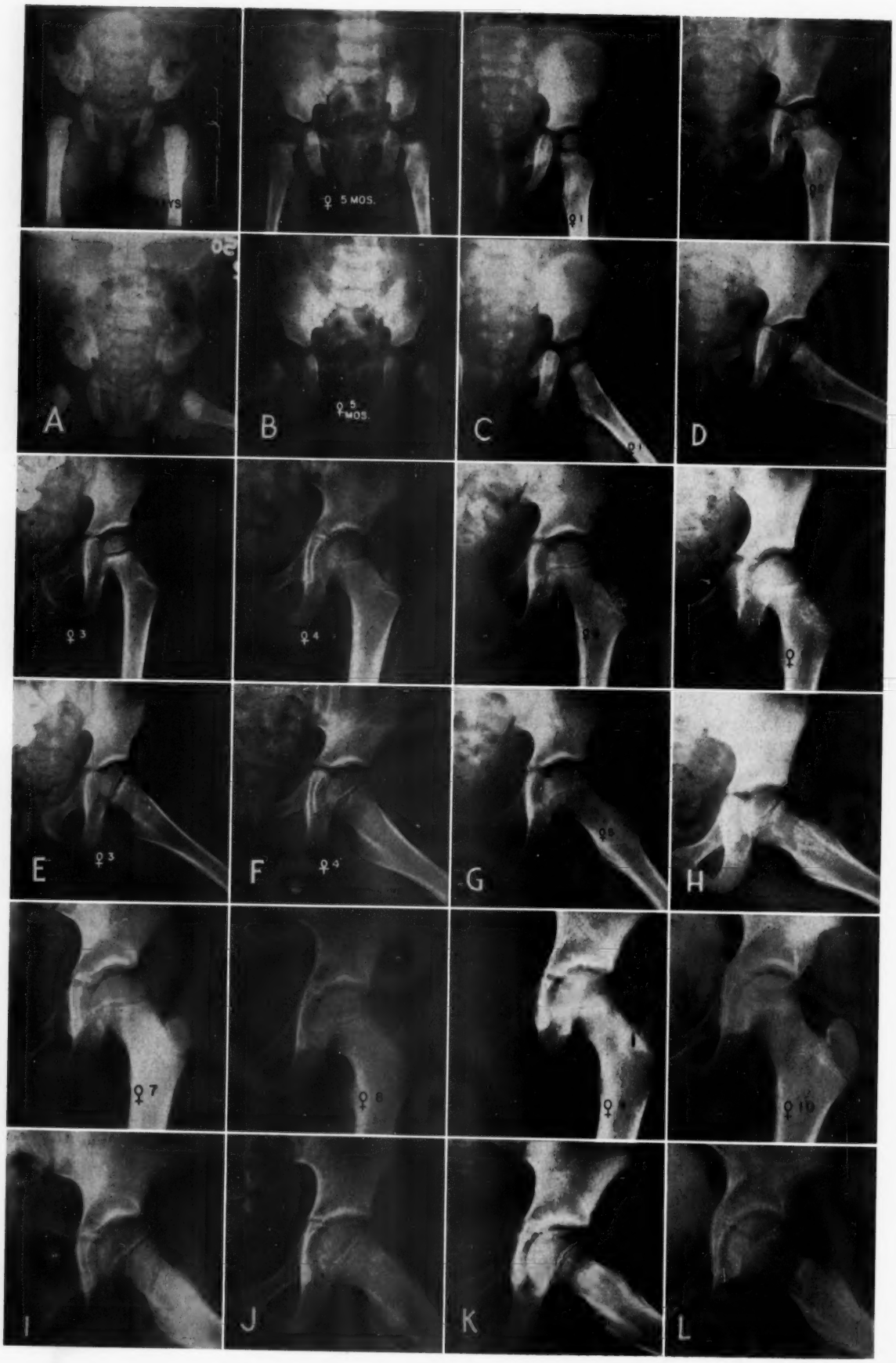
This technique consists of projecting both hips simultaneously on single films for anteroposterior and lateral views (Fig. 3). The cassette is placed transversely beneath the pelvis of the supine patient. The anteroposterior view is made with the lower extremities extended and with the medial aspects of both feet in apposition. The hips are then in a neutral position. (The feet are stabilized by means of sandbags.) The tube is placed over the abdomen so that the central ray is projected through the intersection point of the sagittal plane and the transverse plane, passing through the centers of the acetabula. This localization point, in older children and adults, is about 1½ inches above the symphysis in the midline of the abdomen on a line running transversely midway between the anterior superior spines of the ilia and the greater trochanters. For lateral views, the position of the tube and pelvis remain unchanged but that of the lower extremities is changed. They are now held in the "frog-leg" position. The hips are flexed, abducted, and externally rotated so that with the knees flexed the soles of the feet are in complete apposition. Anteroposterior and lateral views are always taken and each view of both hips is shown on a single film.

Study of the normal hip roentgenograms disclosed the following features in the growth of the proximal femur.

1. The *femoral neck* in infancy forms an angle approaching 180 degrees with the

† This series was obtained from a review of the roentgenograms of over 100 healthy boys and girls.

* From the Service of Orthopedic Surgery and the Department of Radiology, Massachusetts General Hospital, Boston. Presented at the Fifty-first Annual Meeting, American Roentgen Ray Society, St. Louis, Mo., Sept. 26–29, 1950.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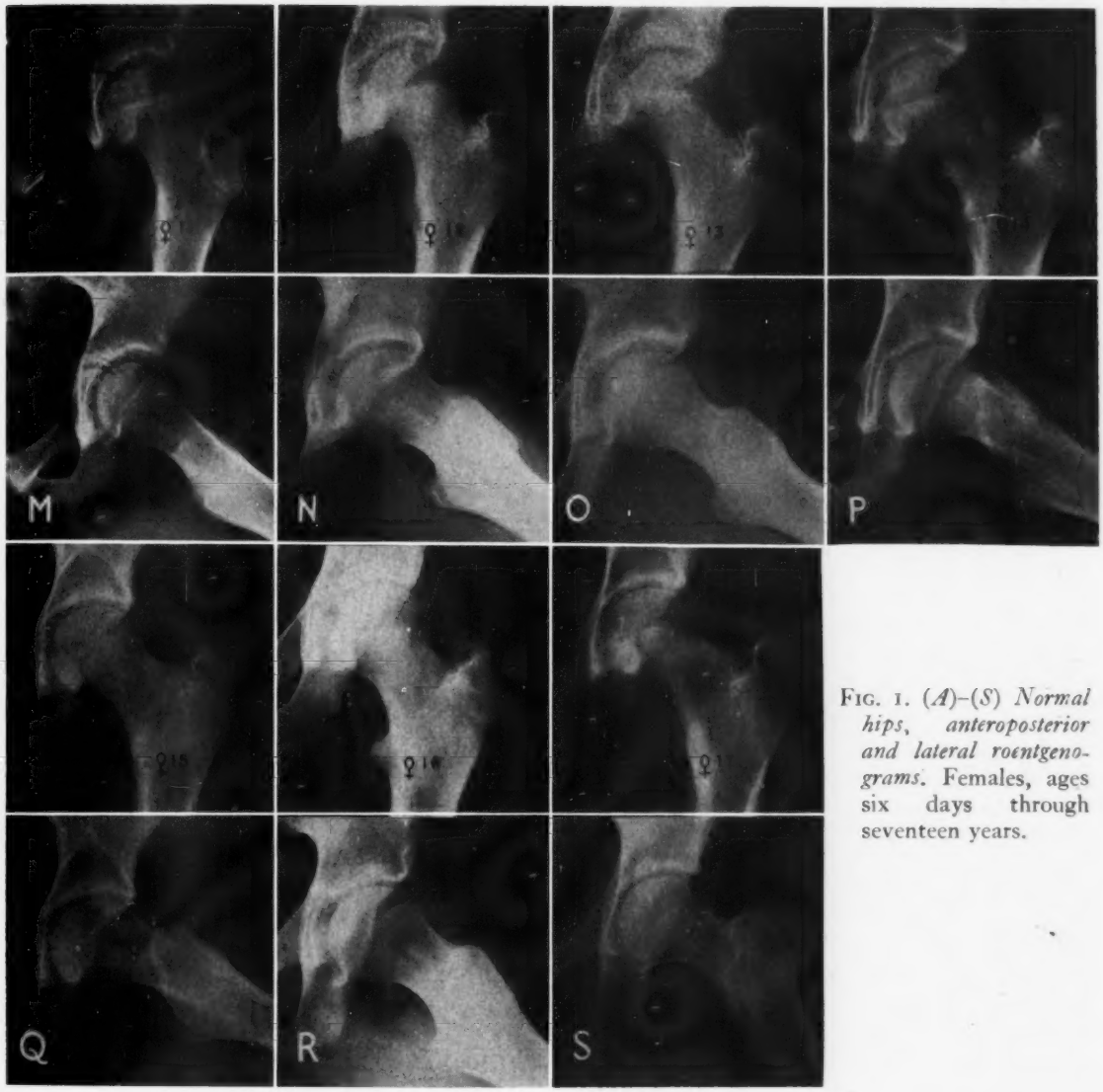

Fig. 1. *(A)–(S) Normal hips, anteroposterior and lateral roentgenograms.* Females, ages six days through seventeen years.

femoral shaft. This angle becomes less with age and weight bearing.

2. *Ossification of the head* appears between the third and seventh months. This ossification center becomes ovoid, but after two years of age gradually assumes the hemispherical contour of the adult head.

3. The *head*, in the anteroposterior view at the age of three, overhangs the neck so that prolongation of the superior neck line proximally transects a portion of the head. This relationship persists.

4. The *ossification center of the greater trochanter* appears between the ages of three and four years.

5. The *juxta-epiphyseal part of the neck*, after the first year, appears slightly cupped in relation to the ovoid head. This relationship is gradually reversed so that by the age of twelve the metaphyseal portion of the neck has become convex and the overlying head concave.

6. The *medial contours of the head and neck* describe a continuous arc in the anteroposterior view after six years of age. In the lateral view the anterior and posterior surfaces of the neck are concave and the wide proximal part of the neck with the head appears spherical.

7. The *epiphyseal plate* in infancy is

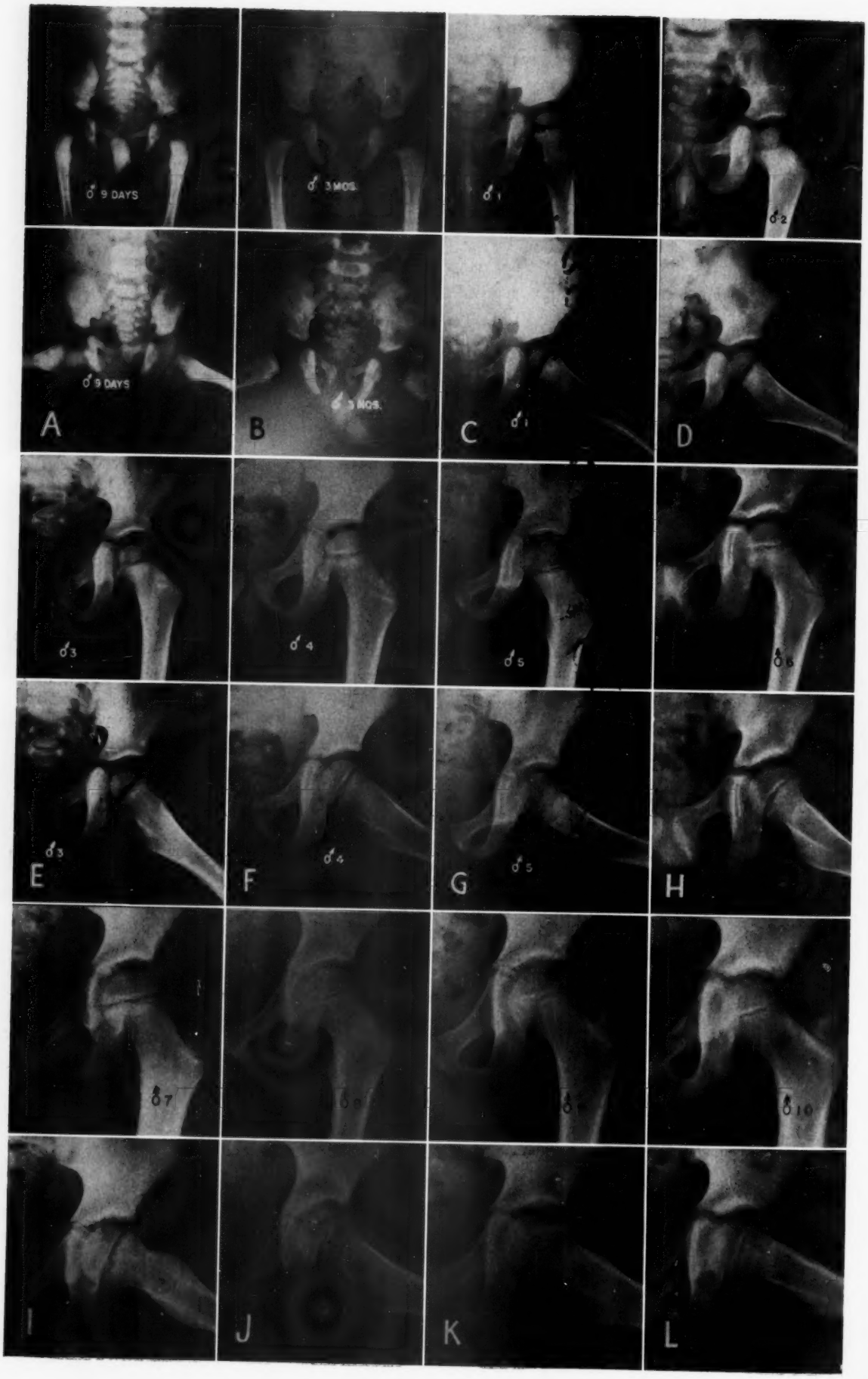
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Fig. 2. *(A)–(T) Normal hips, anteroposterior and lateral roentgenograms.* Males, aged nine days through eighteen years.

wide, particularly at its lateral and medial aspects. With ossification the epiphyseal plate becomes thinner, and the peripheral large gaps are gradually obliterated as the head envelops the neck. The capital epiphysis appears to fuse earlier in its central portion. Fusion of the head and neck occurs between seventeen and twenty years of age in males and one to three years earlier in females.

8. The *ossification center of the lesser trochanter* appears between the ages of eight and thirteen. The epiphyses for both trochanters usually fuse one to two years earlier than the epiphysis of the head.

9. A capital epiphyseal plate wider than the epiphyseal plate of the greater trochanter, in later childhood and adolescence, suggests the possibility of a slipped capital epiphysis.

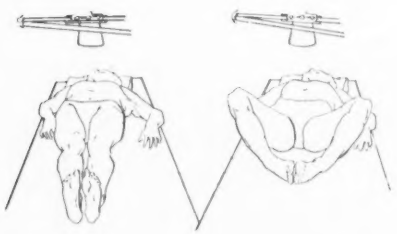
10. There is a wide variation in normal osseous development during any growth period, most marked in late childhood and adolescence, so that determination of bone

age from hip roentgenograms is inaccurate.

Variations from normal become obvious when roentgenograms of patients presenting clinical signs and symptoms of slipping are compared with those of normal hips. This is particularly true for the detection of minute degrees of slipping in the contralateral hip. The recognition of over 40 per cent bilateral involvement in our series[1,2,3] was made possible by such comparison (Fig. 4).

The diagnosis of any degree of slipping depends on the demonstration of changes in the anatomic alignment of the femoral head and neck as seen in the anteroposterior or lateral view of the hip. Concomitant features, such as atrophy and periosteal proliferation will be discussed later. Normally in the anteroposterior view the head and neck should describe a continuous arc medially (Fig. 5). The lateral aspect of the head overhangs the neck and is transected by the prolongation of the superior neck

POSITIONING FOR BILATERAL HIP ROENTGENOGRAPHY



ANTEROPOSTERIOR LATERAL

Both hips are included on a 14 x 17 inch film placed transversely.

The tube is centered above the midpoint of a line connecting the acetabula.

FIG. 3

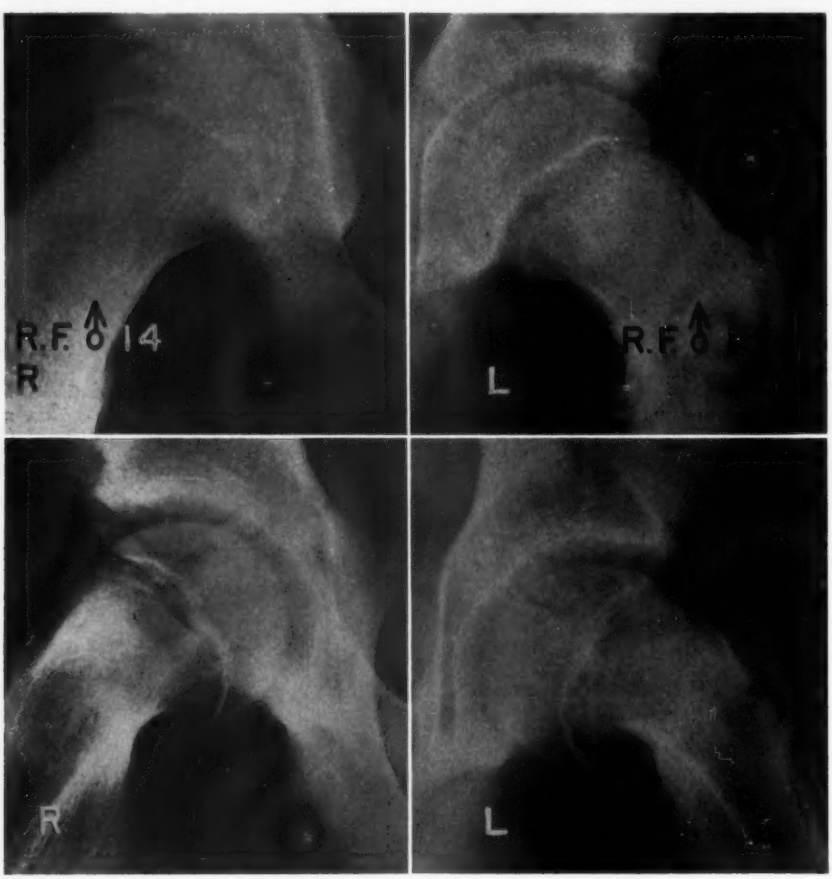


FIG. 4. *Bilateral slipping.* R. F. Slipping occurred first in the left hip and was treated by open reduction and nailing. Contralateral slipping was diagnosed seven months later during routine follow-up and was nailed in situ while minimal.

line proximally. The amount of head transected by this line is dependent partially upon the direction and degree of hip rotation, and is greatest in extreme internal rotation. In the lateral view the hemispherical capital epiphysis is symmetrically placed in relation to the metaphysis of the neck. The neck is narrow at its waist and flaring at its ends. Thus in this projection, the head together with the adjoining wide part of the neck assumes a spherical contour. When any one of these characteristics is altered, the diagnosis of slipping must be considered.

Slipping of the head may be posterior, and may be recognized early only in the lateral view (Fig. 6); but if late, it may be seen also in the anteroposterior projection. With further posterior slipping the head, in the anteroposterior view, will be projected through the proximal portion of the neck and will appear circular in outline. Slipping may be medial (Fig. 6 and 7) and if early, dectectable only in the antero-

Fig. 5. *Early changes in minimal slipping.* (*A*) Normal hip for comparison. (*B*) R. S. The epiphyseal plate is widened. In the anteroposterior view the projection of the superior neck line does not pass through the head. The upper arrow points to a zone of decalcification. In the lateral view the arrow points to the gap resulting from slipping.

posterior view. In this view, because of the medial displacement, the superior metaphyseal portion of the neck will be bared and projection of the superior neck line proximally will not transect the head. Either type of slip may predominate in any given case but with progression both posterior and medial types of slipping appear.*

* By convention the position of the head relative to the neck has been used to indicate the direction of slipping.

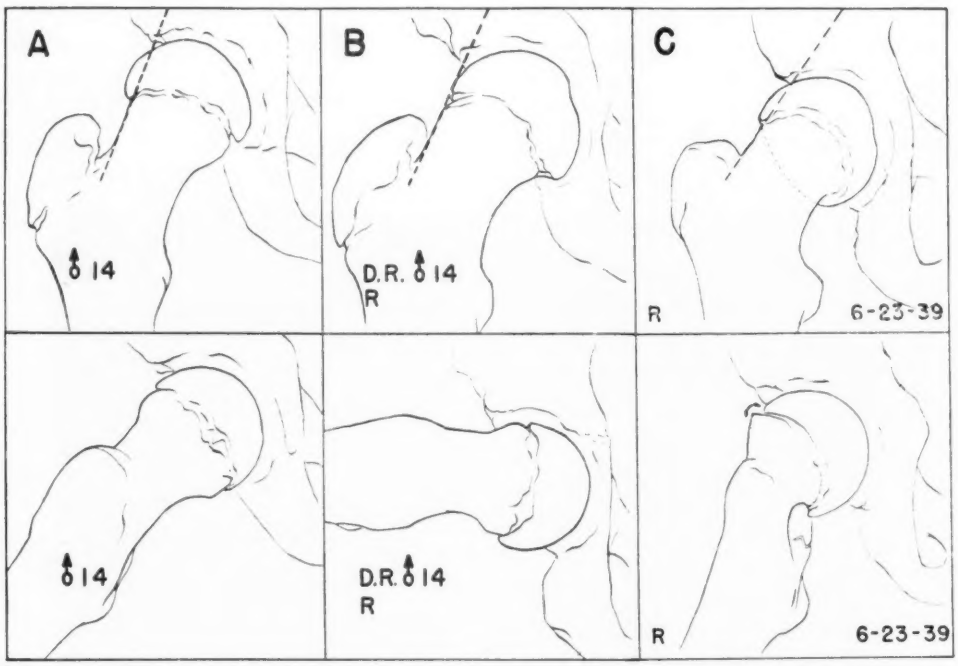


FIG. 6. *Medial and posterior slipping.* (*A*) Normal hip for comparison. (*B*) Medial slipping. In this case slipping is detectable only in the anteroposterior view where the head is not transected by the prolongation of the superior neck line. (*C*) Posterior slipping. In the anteroposterior view the posteriorly displaced head is projected through the proximal portion of the neck. In the lateral view the amount of posterior slipping is denoted by the curved arrow.

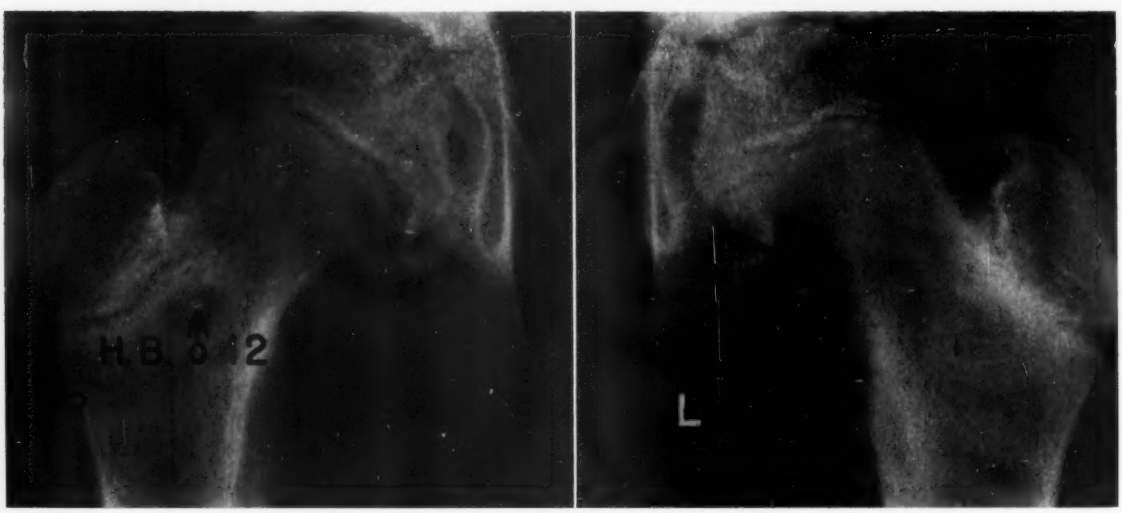


FIG. 7. *Minimal medial slipping.* H. B. The left hip is normal. In the anteroposterior view of the right hip the superior neck is bared at the epiphyseal plate. The projection of the superior neck line does not pass through the head; the medial contour of the head and neck does not describe a continuous arc. Lack of callous formation at the inferior junction of the head and neck suggests that the slipping is recent.

Changes in the bony structures associated with malalignment of the femoral head and neck depend for their severity upon the duration and the rate of progression of the slipping and the absence of normal weight bearing. The earliest manifestation of slipping (Fig. 8) is associated with widening and irregularity of the epiphyseal plate, due to the localized decalcification of the proximal portion of the neck. Decalcification of the head produces in contrast a sharply delineated epiphyseal margin. The medial juxta-epiphyseal portion of the neck may present a localized area of increased radiability. Periosteal proliferation occurs at this site and also at the posterior juxta-epiphyseal margin of the neck. Where the neck is bared superiorly it acquires an angular contour early. As the neck adapts itself to the new position of the head the anterior neck surface tends to lose its concave outline and assume a straight margin. There may be minimal reaction along the anterior neck surface. As slipping progresses the atrophic uncovered portion of the neck takes on a rounded contour (Fig. 9). With the appearance of the slip, adaptive changes occur in the neck towards realignment with the head. These changes are atrophic superiorly

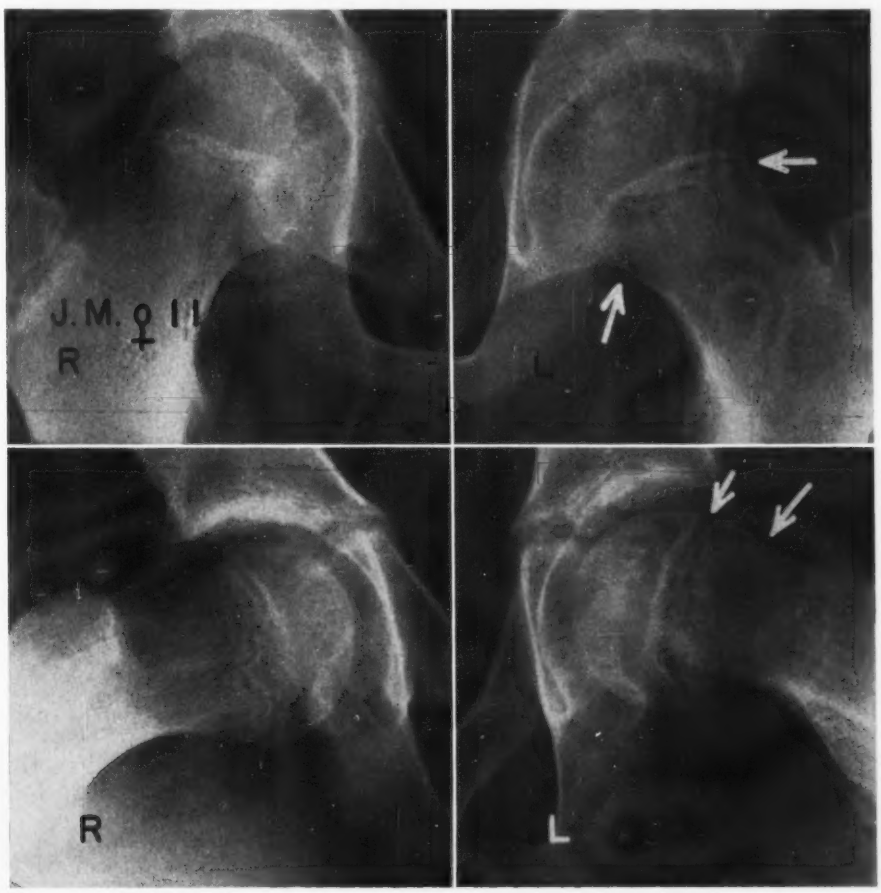


Fig. 8. *Stigmata of minimal slipping.* J. M. The right hip is normal. On the left the epiphyseal line is widened and irregular. *Anteroposterior roentgenogram:* The projection of the superior neck line cuts off less of the head than in the normal right hip. The upper arrow points to the medial displacement of the head and resulting bared neck. The lower arrow indicates localized rarefaction of the inferior neck. *Lateral roentgenogram:* The arrow nearest the acetabulum indicates posterior slipping. The other arrow points to the straightened anterior neck surface which is slightly irregular in contour due to reactive change.

and anteriorly, and proliferative inferiorly and posteriorly. Periosteal proliferation occurs at the inferior and posterior juxta-epiphyseal margins of the neck. This peri-

cases, prolongation of the superior neck line proximally transected less of the head than normally or missed it entirely. There was periosteal proliferation at the inferior

FIG. 9. *Marked posterior slipping.* P. A. Roentgenograms of September 19, 1945, show the characteristic widening and irregularity of the epiphyseal plate; absorption is present in the uncovered neck superiorly and anteriorly. There is callous formation inferiorly and posteriorly at the proximal neck which, together with the adjacent head, forms the "crow's beak." Roentgenograms of November 14, 1947, show the appearance of the head twenty-six months after open reduction and nailing.

osteal response becomes marked with further slipping and, combined with the inferior and posterior margins of the head, forms the so-called crow's beak.

A wide, irregular epiphyseal plate with a sharply outlined metaphyseal border of the head was found in the *anteroposterior* view in 82 per cent of our *early* cases. Generalized atrophy of the hip region was present in 72 per cent. In 62 per cent of the junction of the head and neck in 71 per cent; downward or medial slipping was apparent in only 68 per cent. It is obvious, therefore, that a number of early "slips" could have been missed if only anteroposterior views had been taken.

In the *lateral* view, a posterior or backward displacement of the head was apparent in 98 per cent of the *early* cases. The normal concavity of the anterior neck

line was lost in 69 per cent; periosteal proliferation at the posterior junction of the head and neck appeared in 79 per cent. This emphasizes the fact that the salient diagnostic stigmata are not always present in all views.

In our experience there is no "preslip" stage. If the roentgen examination includes both anteroposterior and lateral projections slipping cannot be missed; if it is not demonstrated in one view it is always shown in the other, and it is obvious when compared with the "normals."

A shorter and broader femoral neck was found in 86 per cent of the cases with *marked slipping*. The superior and anterior concave contour of the neck became straightened or convex in 94 per cent. In all cases with marked slipping the juxta-epiphyseal superior or anterior border of the neck became markedly decalcified after its separation from the epiphyseal plate. The corresponding inferior and posterior portions of the neck developed bony overgrowth or callus which, together with the projection of the displaced head, formed the "crow's beak." With progression of slipping the head migrated closer to the lesser trochanter.

Comparison of the patient's roentgenograms with "normals" not only enables one to recognize slipping but to visualize the correct position of the head for anatomic replacement. The degree of slipping is always measured in the view that shows the greater amount of displacement.

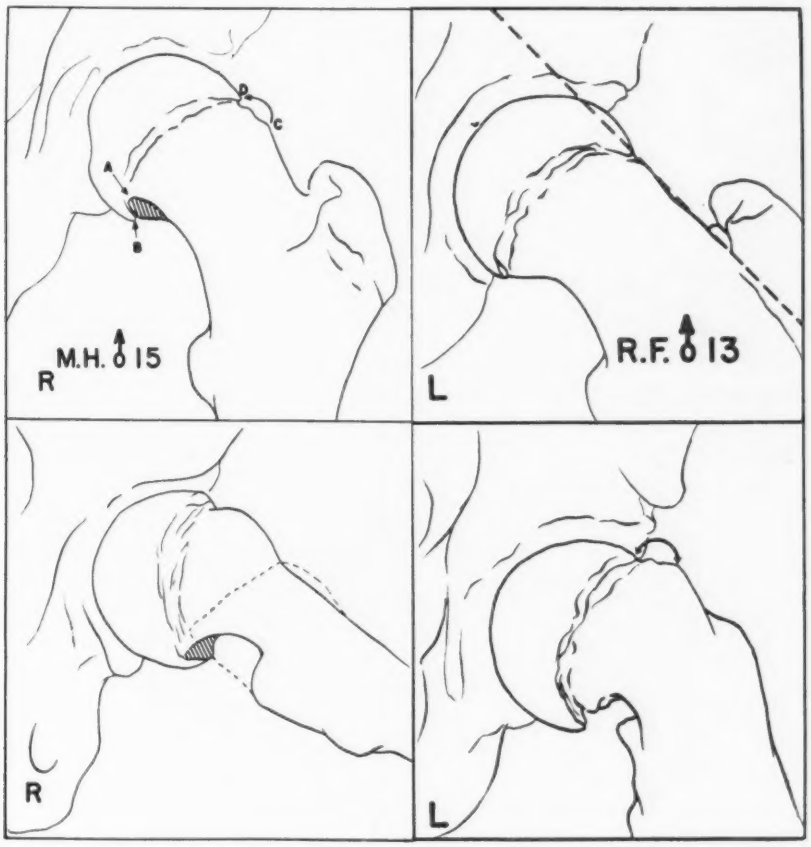


Fig. 10. *Measurement of the amount of slipping.* The amount of displacement is measured along the arc through which the head has slipped. In Case M.H., where medial displacement predominates, measurement is made in the anteroposterior view while in Case R.F., where the greatest displacement is posteriorly, measurement is made in the lateral projection.

Since slipping occurs through an arc, accurate measurement is made along the arc described (Fig. 10). If it is under 1 cm. slipping is minimal and should be treated by nailing in situ. If it is greater than 1 cm., open operation, replacement of the head, and nailing are necessary.

It has been our experience that the minimal "slips" nailed in situ showed, after approximately three years, normal motion in 90 per cent and 96 per cent normal hip function. Those nailed after arthrotomy and replacement, because of a marked slipping, showed 85 per cent normal motion and 92 per cent normal hip function. Aseptic necrosis did not occur. Nailing insures the patient against further slipping of the epiphysis and accelerates epiphyseal fusion.

Periodic re-examination, at least bimonthly, is imperative so that any change in the position of the nail or character of the reaction about it will be readily recognized. The standard technique of bilateral hip roentgenography must be used throughout the follow-up period, which should continue until the epiphyses are fused on both sides because asymptomatic slipping may appear in the contralateral hip (Fig. 11 and 12). Since both hips are always shown on the same film the earliest signs of contralateral slipping will be evident. The patient is cautioned to return if he develops pain or limp in the opposite hip.

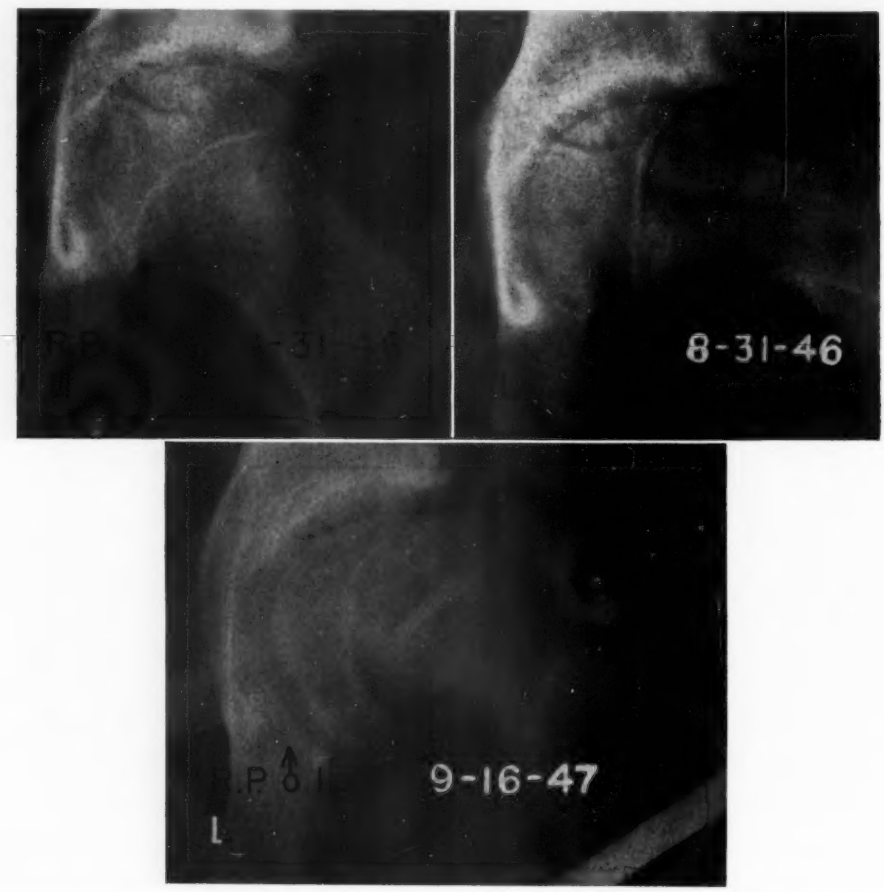


FIG. 11. *Asymptomatic minimal slipping.* R.P. On August 31, 1946, minimal posterior displacement is evident in the lateral view although the patient was without signs or symptoms referable to this hip. One year later marked slipping has occurred.

SUMMARY

Early diagnosis of slipped capital femoral

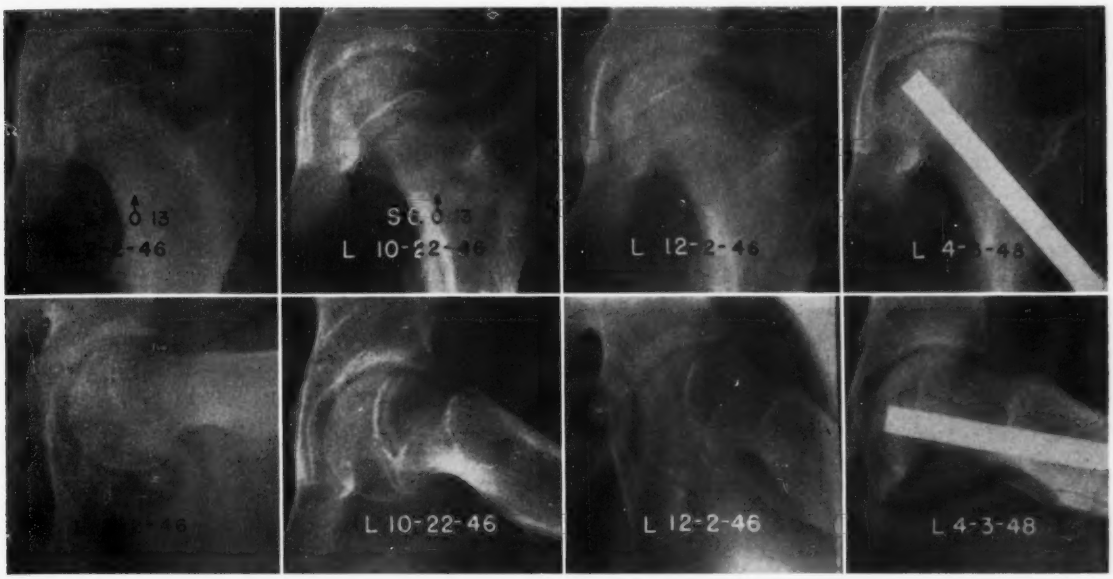


FIG. 12. *Progression of slipping initially asymptomatic.* S.G. February 2, 1946: Early asymptomatic untreated slipping. October 22, 1946: Further posterior slipping. December 2, 1946: Slipping marked and now producing symptoms. April 3, 1948: Appearance two years following gentle manipulation and nailing in situ.

epiphysis permits a simple and efficacious treatment; namely, nailing in situ. The diagnosis may be suspected clinically but becomes definite only when demonstrated on the roentgenograms.

A knowledge of the roentgenographic anatomy of the normally growing hip facilitates recognition of minimal slipping. The significant features in the development of the proximal femur have been demonstrated by a series of "normal" hips. These "normals" have been used as standards for comparison with suspected hips to indicate the severity of the slip and the necessary treatment.

A standard method of positioning for bilateral hip roentgenography in both anteroposterior and lateral projections has been presented.

The stigmata of early and late slips have been described and illustrated and their diagnostic importance evaluated.

Emphasis has been placed on the necessity for both anteroposterior and lateral roentgenograms because slipping may be evident in only one of the two projections. The existence of a "preslip" stage is denied by the use of these two views.

The importance of periodic re-examination has been stressed.

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Boston, Mass.

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DISCUSSION

DR. LAURENCE L. ROBBINS, Boston, Mass. After this presentation it is difficult for me to do much more than to reiterate some of the important points that have been made.

Of course, the study of the normal is extremely valuable to any radiologist, because unless one knows the normal he can never recognize the minimal, abnormal changes that may be found.

Dr. Klein has presented the important points

that we consider are necessary to the early diagnosis, and this leads to earlier treatment. Perhaps of greatest significance in this regard is the fact that with proper technique we have not found any such condition as a preslipping.

It is extremely important that proper treatment be instituted. The radiologist is probably the most often used consultant, and it is his opportunity to direct, albeit indirectly, the treatment in the proper channel.

I believe you all will remember that ten years ago a youngster who had a slipped epiphysis was in for a long period of illness. Many of those children were laid up for as many as two years, and even then some of the results were far from good. Some of the children actually were crippled for life; many required arthroplasties later.

Dr. Klein became interested in nailing these slipped epiphyses a good many years ago. It is largely through his efforts that a disease in which a long period of illness had been entailed can now be treated with perhaps two to three weeks of hospitalization, with (what is more important) a very good outlook for the future.

Admittedly, and I think Dr. Klein will agree, not all the results have been perfect; but their results with nailing have been so good that in the past their veracity has been doubted. I believe Dr. Klein can substantiate everything he has said, and I only regret that he has not talked more about the results of treatment.

There is one question that I should like Dr. Klein to answer: How much sooner does fusion occur after nailing; and, associated with this, how much shortening of the leg is noted?

It seems from this presentation that it is the obligation of the radiologist to be certain that proper technique is carried out so that he may make the diagnosis as early as possible and to see that the patient is directed in the proper channels for proper treatment.

DR. GEORGE LEVENE, Boston, Mass. I should like to ask Dr. Klein a question: It is held by some that the use of the Smith-Petersen nail in these cases is objectionable on the ground that in driving the nail in it displaces the capital epiphysis and increases the deformity. I would like to know how Dr. Klein feels about that.

DR. KLEIN (closing). As Dr. Robbins requested, we have found that fusion of the capital epiphysis occurred within four to eight months postoperatively in the open reduction cases, and six to sixteen months postoperatively in the cases nailed in situ.

We found also that in the cases that had an open reduction, fusion in the operated hip occurred five to thirty-five months ahead of the fusion in the contralateral sound hip. In the cases nailed in situ it was our experience that fusion occurred eight to twenty-one months earlier than it did in the contralateral hip. Apparently nailing does speed up the fusion and accelerates it.

In answer to Dr. Levene's question about displacing the head as the nail is driven through the neck up across the epiphyseal plate into the head itself, there have been reports that the head has been spun around by the nail driven up against it, but we have not had that trouble.

Once we have the head reduced and the anteroposterior and lateral films taken show it so, we drive a wire up through the head and through the acetabulum, because we feel that these children have a great deal of cartilage, and running just one wire through it won't hurt the cartilage. As soon as you do that, the head cannot spin and does not become displaced.

Vol. 66, No. 3

THE ROENTGENOLOGICAL IDENTIFICATION OF VICTIMS OF THE "NORONIC" DISASTER*

By A. C. SINGLETON, M.D., F.F.R.
TORONTO, CANADA

IN THE early hours of the morning of September 17, 1949, there occurred in Toronto one of the worst maritime disasters recorded in peace time. Fire broke out in the Great Lakes liner "Noronic," a thirty-seven year old passenger vessel of 7,000 tons. In the course of a very few minutes the ship became a blazing inferno, in which 119 of her 527 passengers lost their lives. One hundred and thirty-six others were treated in hospitals, 45 of whom were admitted. Of the 119 dead, 3 died in the hospital, 1 was dead on admission, 5 died of drowning, and the remainder died in the ship, of suffocation or burns, or both. Of the dead, 41 were male and 78 were female. Of the survivors, 146 were male and 262 female, the relationship of males to females being approximately the same among the victims and the survivors.

The fact that the fire occurred at 2:30 in the morning added greatly to the number of casualties, in that many of these individuals were suffocated in their rooms before they could make any effort to get out, and rendered identification of bodies considerably more difficult, as they were attired only in their night clothes, had taken off their jewelry and removed their dentures, means by which identification can frequently be established.

The identification of a body by means of comparison of postmortem with antemortem roentgenograms is not new. In 1926 Culbert and Law[1] reported the identification of a body by comparison of antemortem and postmortem roentgenograms of the nasal accessory sinuses and mastoids. In 1944 Dutra[2] described the identification of a body burned beyond recognition in an automobile. The roentgenological part of the identification consisted of a comparison of films of a fractured femur, which had been made some months prior to the death of the individual, with roentgenograms of the femur of the body. In the famous Ruxton case[3] roentgen rays played a part in the matching of dismembered remains of two bodies and indicated the sex and probable age of the bodies but did not assist in any way in establishing the identity of the two victims. No record, however, of the use of roentgen rays in the identification of multiple casualties has been found in the literature. When we were asked on September 18, 1949, by the Attorney General of Ontario to conduct roentgenological examination of the victims for comparison with any obtainable roentgenograms of these individuals made before death, in an attempt to assist in identification, we were shocked by the large numbers of bodies to be identified and by the terrific destruction and distortion of these remains, many of which had considerable portions of their skeletons burned away and the remaining portions badly charred. Extremities and angles of the bodies suffered most. Many arms and legs were burned off completely. Extensor surfaces of knees, elbows and shoulders were frequently destroyed, and in many the cranial vaults were burned away. In many the chests were grossly destroyed. The lungs in most instances were solid, in many cases burned. Pneumothorax and pneumoperitoneum were common. The lumbar spines, pelves, and hips were better preserved than the remaining portions of the bodies.

With the aid of two manufacturers of roentgenological equipment we were able to set up three mobile roentgen-ray units in the Horticultural Building of the

* From the Departments of Radiology, University of Toronto and the Toronto General Hospital. Presented at the Sixth International Congress of Radiology, London, England, July 22–29, 1950.

Canadian National Exhibition, which was used as a temporary morgue, and with our own technicians and those from other hospitals in the vicinity we were actually in operation, roentgenographing these remains some five hours after the request for this service was received. At the outset we had little idea of the scope of the task ahead of us and our first procedure was to make routine survey films of each individual body. This consisted in making anteroposterior projections of the trunk in sections, anteroposterior and lateral roentgenograms of the skulls and anteroposterior and lateral roentgenograms of the extremities. This preliminary survey was completed on the 78 bodies in less than forty-eight hours. The remainder of the 119 bodies had been identified by other means by this time and no roentgenological investigation was required in those cases.

This was by no means the end of the roentgenological examination but rather the beginning. As we began receiving films of these persons made prior to death and obtained by the Red Cross, it was frequently necessary to go back and make further films of similar areas of a number of victims in one or numerous projections for accurate comparison with films submitted. Views of ankles, feet and wrists in multiple projections became necessary, as these types of films were submitted for comparison with films of the victims. Indeed, this making of further films went on continuously for three weeks after the tragedy and at intervals after that time, as further antemortem films were received or as other data compiled by the pathologist suggested the possibility of other identifications. The last postmortem film was made on November 29, 1949, ten weeks after the disaster.

The legal implications of identification of a body and proof of death are great. Death must be established for insurance or other inheritance purposes, or for the right of another individual to re-marry. The sentimental importance to relatives is frequently very great.

In our roentgenological identification old fractures or infections played very little part, but congenital bony anomalies were of considerable value. In most cases, however, identification consisted of an accurate matching of normal bony landmarks, particularly margins of joints. The conformation of the bony structures of an individual is a permanent characteristic of that individual, and is not subject to change by plastic operations, the growth of a beard, putting on of a wig or dyeing of hair. The accuracy and ease of roentgenological identification depends upon obtaining satisfactory antemortem roentgenograms of some part of an individual, and good corresponding roentgenograms of the victim to compare with them. In the present instance considerable difficulty was encountered in obtaining good films of the victims. Absence of considerable portions of these bodies has been referred to. Distortion of the remains, due to rigor mortis and burning, with consequent difficulty in getting the bodies into suitable positions for roentgenography, was encountered. Many of these bodies were grossly impregnated with foreign bodies and many repeat examinations were required, often after thorough washings of victims to remove foreign bodies.

In the early stages of the investigation each set of films which came in had to be compared with 27 male specimens or with 51 female specimens. As the pathologists began compiling details, not only of roentgen examinations but of dental examinations, histories of operations and illnesses, and from examinations of the bodies, clothing and jewelry and from all other information available, this work was very much lightened by the process of exclusion and with each set of films which then arrived we received from the pathologist an exclusion list of likely and unlikely possibilities. This very definitely narrowed our search and allowed us to concentrate on a small number of likely victims' films to compare with the antemortem films submitted.

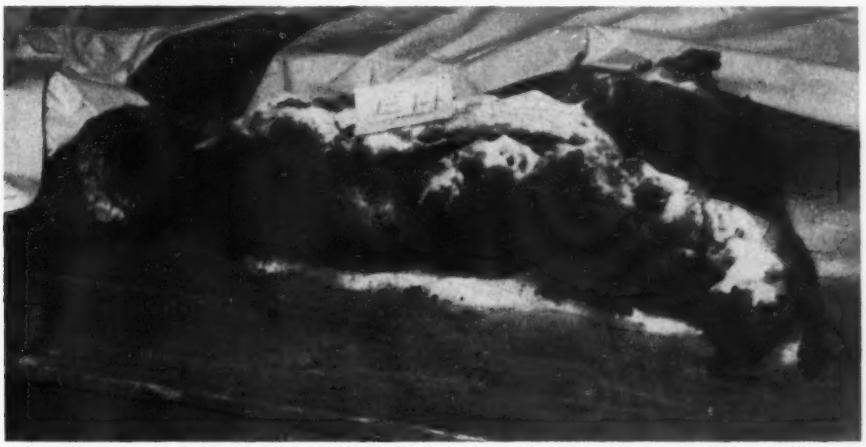

Fig. 1. Case 1. Police photograph of victim E-14, showing gross destruction of extremities and trunk. Remains are partially covered with sawdust.

In all, roentgenological examinations were carried out on 79 bodies. We used 1,020 roentgen films or an average of 13 per specimen. We received from elsewhere roentgen films of 35 individuals. The films submitted were of varying portions of the human body, and came from various American border cities, mostly from Detroit and Cleveland. The oldest films received were made in 1936, just over thir-

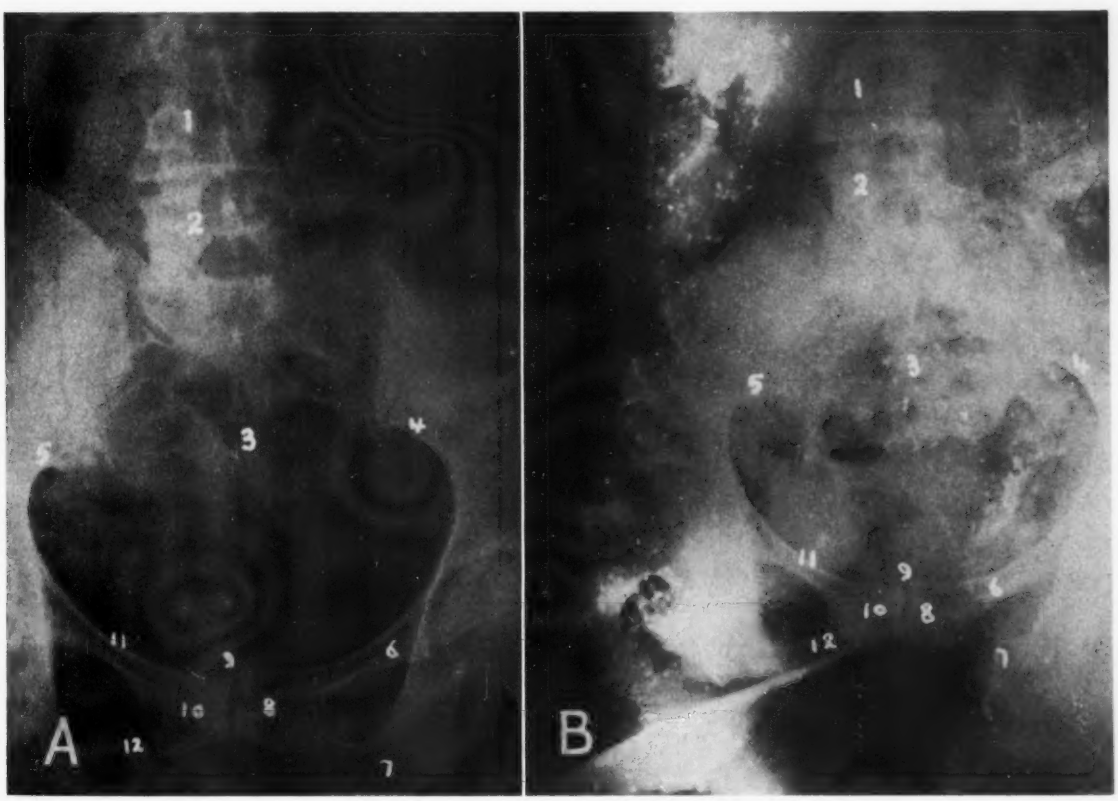

Fig. 2. Case 1. Shows roentgenological comparison of the pelvis of Mrs. F. L., made in 1936 (*A*), with the corresponding portion of specimen E-14 (*B*). All bony points match in every essential and positively establish identity of the individual.

teen years before the disaster. In most cases only a roentgenogram or roentgenograms of one part of the body were received. In a few cases roentgenograms of multiple portions of the body were received, which made identification more simple and perhaps more positive. In 5 cases roentgenograms were known to have been taken within five years of the disaster but were unavailable for comparison, having been destroyed, or could not be traced.

Allowing for the cases of multiple area comparisons, the portions of the body yielding positive identification were as follows: skull—4, cervical spine—2, thoracic spine and chest—13, lumbar spine and pelvis—9, foot and ankle—1.

In a number of cases the identification was very simple and very striking. In a large majority, however, the process consisted in a slow, painstaking task of matching individual points of an area of a human body with corresponding films submitted, in most cases working with a magnifying glass to bring out the finer details of bony outline and the structures of joints, obscured in many cases by foreign bodies.

Of the films of the 35 individuals submitted from outside we were able to match 24 with sufficient assurance that we felt identification was positive by roentgenological investigation alone. In 5 identification was not conclusive, in that, while a number of points of the comparison films appeared to match, we did not feel sufficiently certain to make a positive identification. Into this group, in which the roentgen ray was of assistance, must go an undetermined number of cases in which identification suggested by other means was excluded by incompatible roentgeno-

FIG. 3. Police photograph showing the remains of two bodies. The lower one, numbered E-4, is the body in Case 11.

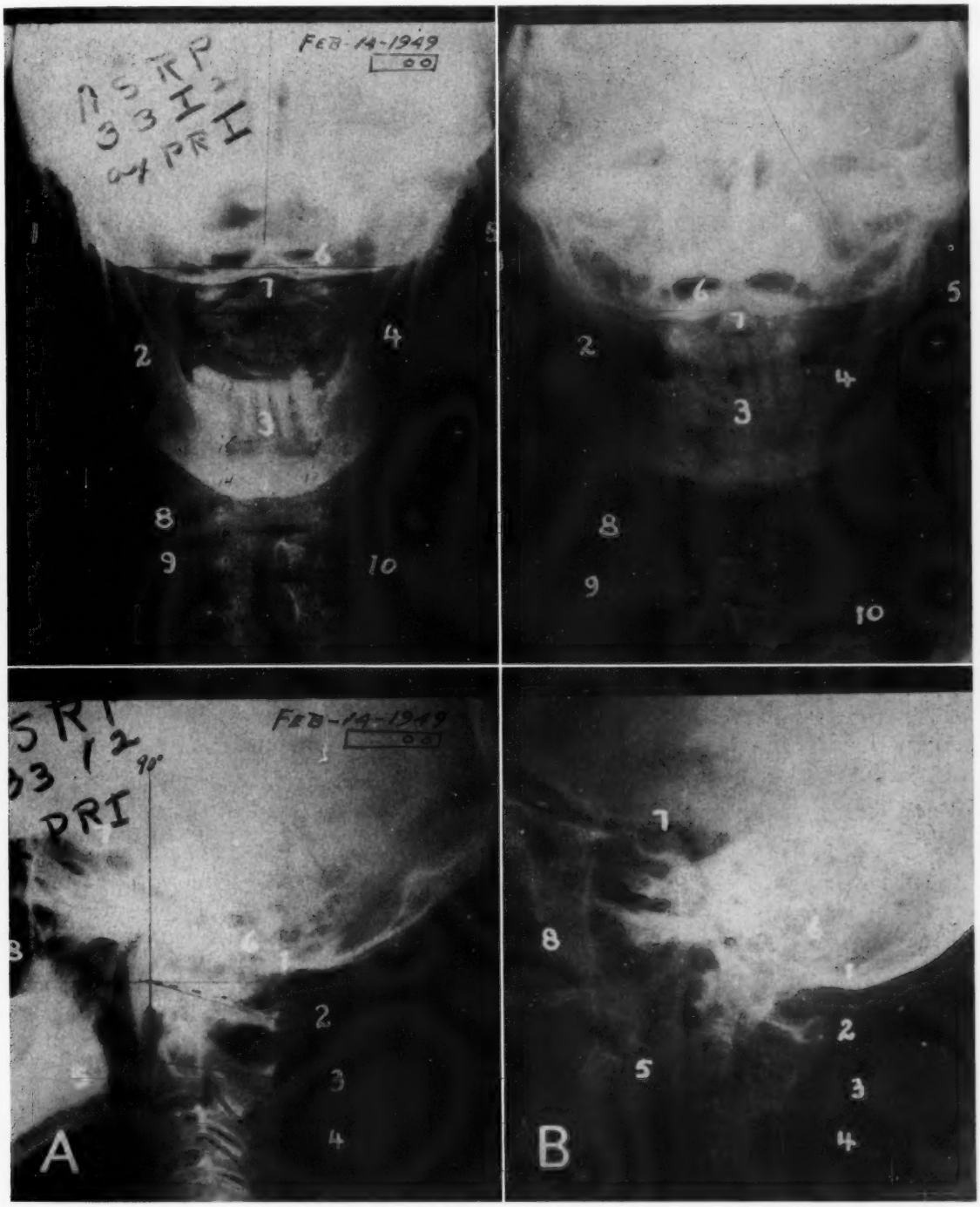

Fig. 4. Case 11. Shows on the left anteroposterior and lateral films of the upper cervical spine and base of the skull of Mrs. B. M., made on February 14, 1949 (*A*). The two films on the right are corresponding anteroposterior and lateral views of victim E-4 (*B*). The identifying points here are extremely numerous and are marked by the figures on the two pairs of comparison films.

logical comparison. There were 6 cases in which we were unable to match films submitted, or to be of any assistance. Destruction of extremities of victims, with which to compare extremity films submitted, accounted for 5 of the 6 cases. In the sixth

FIG. 5. Case III. Police photograph of disaster victim B-11, showing extreme destruction of extremities and torso.

case a lack of bony detail in the antemortem film submitted was responsible for failure. This was a 70 mm. survey chest film.

It is interesting to compare the results of roentgenological identification with finger-print identification in this study. Of the total casualties, only 38 were suitable for finger-print study. Of these 38 cases, 15 were finger-printed. In 6 of the 15, the finger prints constituted a major point of identification and in 9 they yielded contributory evidence.

FIG. 6. Case III. Comparison of lateral roentgenograms of the foot of Mrs. P. D., made on March 20, 1947, in the upper half (*A*) of the illustration, the lower half (*B*) showing the lateral roentgenogram of the foot of "Noronic" victim B-11. A number of the matching points are marked by figures. There is also the identification of the sesamoid under the head of the first metatarsal.

The following cases illustrate various types of roentgenological identification.

CASE I. Our first case was of a woman, Mrs. F. L. (Fig. 1), and identification was made by comparing a film of the woman's pelvis and lumbar spine, made in 1936, with a corresponding portion of Specimen E-14 (Fig. 2). It will be noted that the symphysis pubis presents a peculiar irregularity on its left side and a ridge running through the ascending ramus of the left pubis, due to an old fracture. Other points of identification were the conformation of the descending pubic rami on both sides, the outlines of the ischia, the structure of the acetabula and a peculiar irregularity of the inferior borders of both sacroiliac joints, the superior border of the sacrum and the bodies and transverse processes of the fourth and fifth lumbar vertebrae. These multiple bony points established positive identification.

CASE II. In this case identification was established by comparison of films of the cervical spine and base of the skull (Fig. 3). Films of Mrs. B. M., on the left, were made on February 14, 1949, and the ones on the right were made of "Noronic" victim E-4 shortly after the dis-

Fig. 7. Case iv. Photograph of victim B-1 showing gross destruction of the extremities, which is so common in these cases.

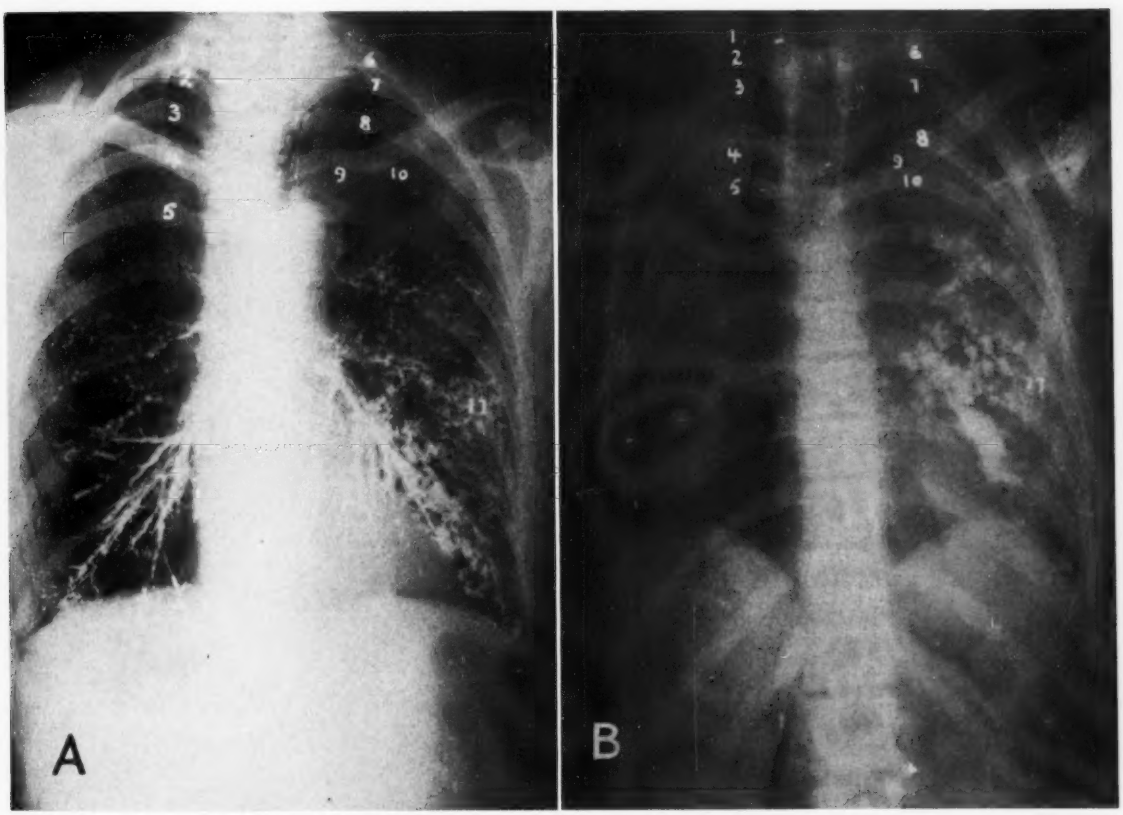

Fig. 8. Case iv. On the left (*A*) lipiodol bronchogram of Mrs. A. B., made on August 23, 1949. On the right (*B*) comparison film of victim B-1. The residual lipiodol shadow corresponds with what one would expect from the original bronchogram but the matching bony points in this case are equally if not more important. Note also the consolidation of the lungs, particularly of the left, and the presence of a right basal pneumothorax and pneumoperitoneum.

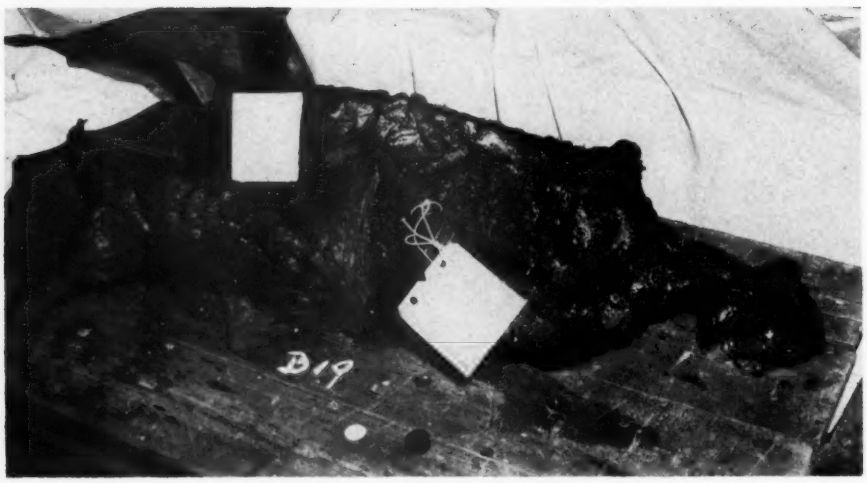

FIG. 9. Case v. Photograph of victim B-19 showing extreme destruction of extremities and of skull. Note intestines extruding through anterior abdominal wall.

aster (Fig. 4). The identifying points here are very numerous. The number and configuration of the remaining lower teeth are identical, the upper jaws being edentulous. The arrangement of the temporomandibular joints, the appearance of the sphenoidal sinuses, the sella turcica and mastoids, and the architecture of the cervical vertebrae are identical. The identifying points are so numerous that they must belong to the same individual.

CASE III. This is the identification of Specimen B-11 as being Mrs. P. D. (Fig. 5), the

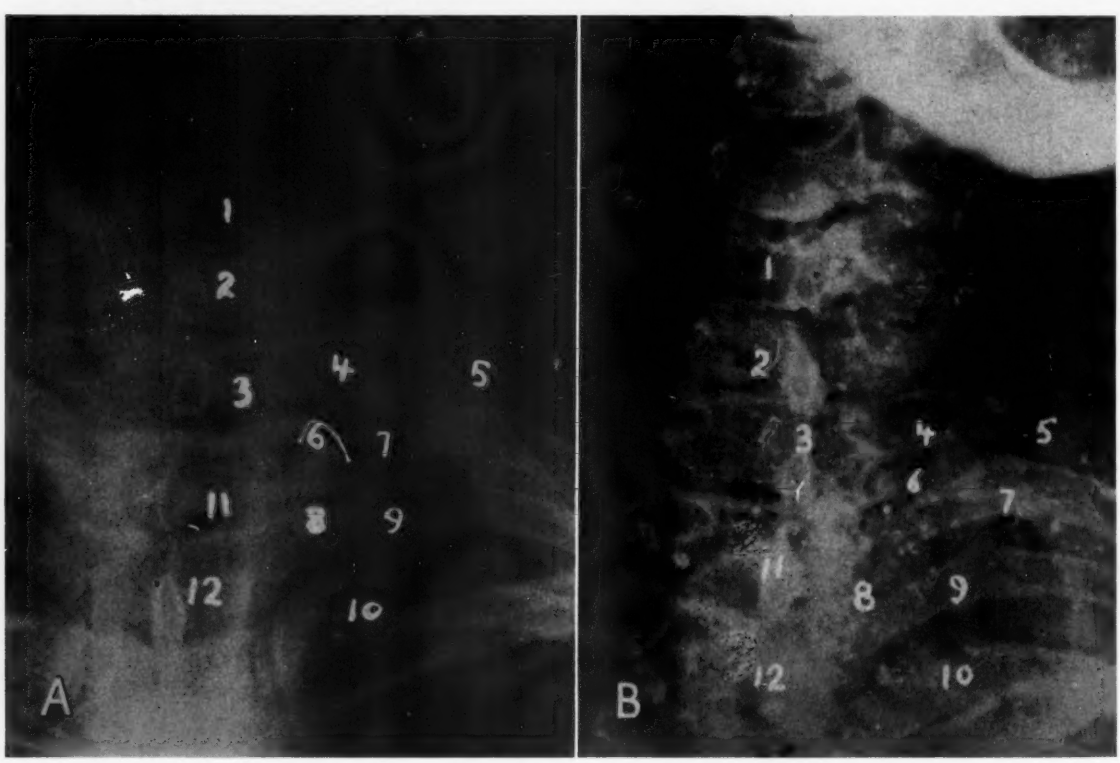

FIG. 10. Case v. Comparison of roentgenograms of the cervical and upper thoracic spine of Mr. F. J., made on March 27, 1949, on the left (*A*), with films of victim B-19 on the right (*B*). See multiple corresponding bony parts numbered, showing identical outlines. Identity in this case was further established by comparison of lumbar spine and pelvis films.

identification being made by comparison of a lateral view of the left foot of this individual made during life with a lateral view of the specimen (Fig. 6). The matching points are the os calcis, which presents a characteristic spur inferiorly, and the tarsal bones and intertarsals articulations. The astragalus has been partly destroyed but the remaining portion is identical. The sesamoid under the head of the first metatarsal matches perfectly, completing the identification.

Case iv. In this case identification started by the matching of chest films submitted in the name of Mrs. A. B. with those of "Noronic" disaster victim B-1 (Fig. 7). The most obvious likeness is, of course, the lipiodol in the lung instilled some months before, but matching bony points were of equal importance in the actual identification: The inner ends of the clavicles, the upper ribs, the lower cervical and upper thoracic vertebrae revealed a large number of identifying points which proved quite conclusively that the films of Mrs. A. B. submitted from elsewhere and the films of "Noronic" disaster victim B-1 were of the same individual (Fig. 8). Further identification was obtained by comparison of films of the skull and dorsolumbar spine in this case.

Case v. In the fifth case, a most interesting identification was that of Mr. F. J. as "Noronic" disaster victim B-19 (Fig. 9). Shortly after the disaster this body was falsely identified by a supposed partner as being another individual entirely. When films of the cervical spine of Mr. F. J. were received, they were found to match identically the corresponding films of disaster victim B-19 (Fig. 10), the matching points being particularly the body and left transverse process of the seventh cervical vertebra, the upper three thoracic vertebrae and the identical conformation of the left upper ribs. Identity was further established by comparison of films of the lumbar spine and pelvis. The roentgenological identification led to a review of the case and to the exhumation of the body from a Toronto cemetery and its transfer to Detroit, where it was buried under its proper name.

Case vi. This illustrative case is the identification of Mrs. F. K. as "Noronic" disaster victim H-1. Shortly after the disaster we received films of the spine bearing the name of Mrs. F. K., showing a very gross degree of scoliosis. A search of the spine films of all female victims known at that time failed to turn up any films even closely resembling those of Mrs. F. K. and we felt that either this woman had escaped from the ship and disappeared or her body had not been recovered. During the later stages of dismantling the ship, thirty-nine days after the disaster, the body of a woman was found in the water in the hold (Fig. 11). Death was due to drowning rather than to burns and she was terribly bloated and unidentifiable by facial features. Roentgenological examination was proceeded with before the autopsy and the films showed immediately that the exact curvature of the spine for which we had been searching so long matched with the films of Mrs. F. K. (Fig. 12). All other points of spinal structure as well as the curvature matched so exactly that the identification was established before the pathologists had started their autopsy.

Fig. 11. Case vi. Body of specimen H-1 recovered from the ship on October 26, 1949, thirty-nine days after the disaster. This victim suffered death from drowning rather than from burns.

Conclusions

The comparison of roentgenograms made

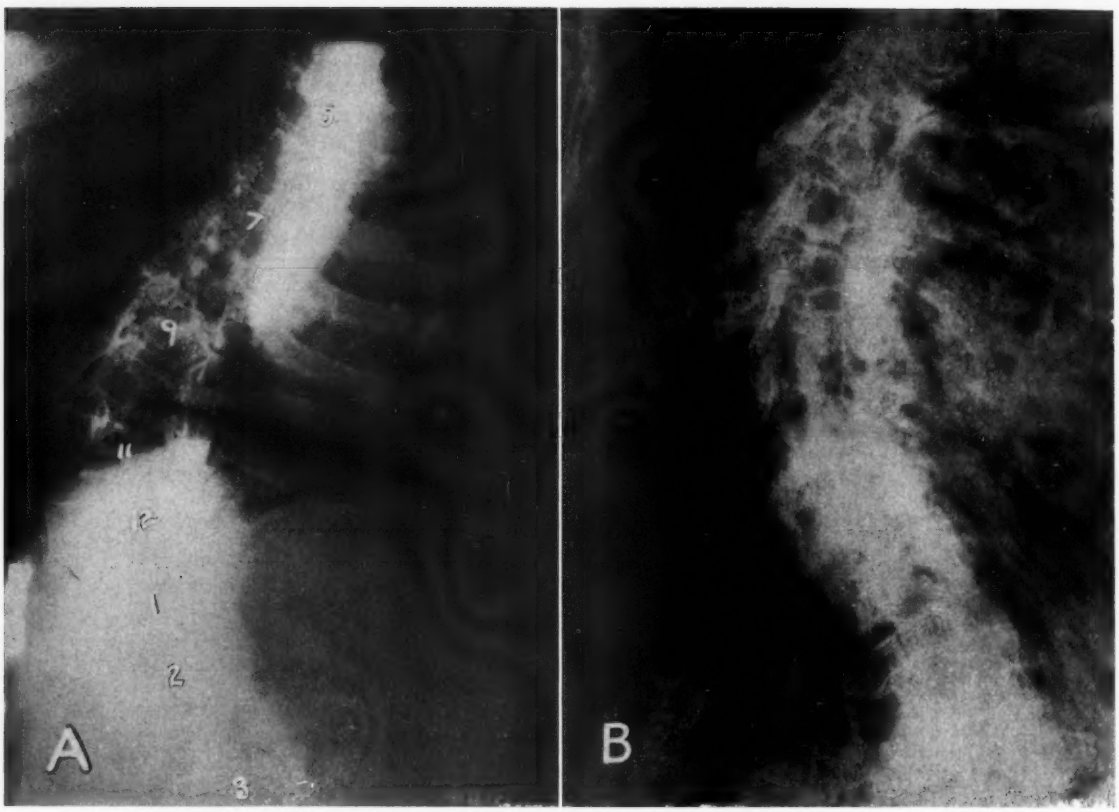

FIG. 12. Case VI. Shows comparison of film of the dorsolumbar spine of Mrs. F. K., made on July 15, 1947 on the left (*A*) and corresponding film of disaster victim H-1 on the right (*B*). The scoliotic curve matches exactly, as do a large number of identifying bony points.

during life with postmortem roentgenograms is a feasible method of body identification. Its success depends upon obtaining satisfactory antemortem roentgenograms and corresponding roentgenograms of the body to be identified. The identifying points of bones are permanent and are not subject to easy destruction. Where positive, the identification warrants being considered as a definite and final means of proof of death and of identification of a body.

In the "Noronic" disaster roentgenological identification was of much greater value than finger-print identification.

Our study would seem to suggest the advisability of routine preservation of all roentgenograms for longer periods of time than is now in common practice, or of microfilming of all roentgenograms before they are discarded.

Space does not permit the giving of credit to the number of radiologists, roentgen-ray technicians and roentgen-ray supply people who participated in this work and who gave so freely of their time and energies. This is recorded in the official report to the Attorney General of Ontario.

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OSTEITIS PUBIS AND ITS TREATMENT BY ROENTGEN IRRADIATION*

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OSTEITIS PUBIS is a distinct clinical entity characterized by a self-limiting, non-suppurative osteonecrosis which usually begins at the symphysis and extends to the pubic bones or, in the more severe cases, as far posteriorly as the ischial tuberosities. It is also described in the literature under the names of periostitis pubis or osteochondritis pubis.

The lesion constitutes, with a few exceptions, a troublesome postoperative complication in urologic surgery and therefore it would seem to be of interest chiefly to the urologist. A careful analysis of the published cases, however, shows that certain diagnostic and therapeutic requirements exist which make the subject one of primary importance also to the radiologist. Thus it is often necessary to accurately differentiate osteitis pubis from true osteomyelitis of the pubic bone since the therapeutic approach and the prognosis vary in the two instances. It is also desirable to distinguish it from metastatic carcinoma of the prostate or other destructive malignant neoplasms of the pelvic girdle with which it is frequently confused. Although the favorable outcome in the osteitis pubis, as a rule, serves to eventually correct this latter error, cases are described in the literature in which unnecessary surgical interventions, such as resection of the affected area,[33,40] wiring of the symphysis,[24] and even spinal chordotomy[10] have been advised or performed because of a mistaken diagnosis. As regards the treatment of osteitis pubis, the interest to the radiologist derives from the fact that, although the disease is self limited, roentgen therapy seems to excel the numerous other methods used for the alleviation of symptoms and shortening of the clinical course of the disease.

REVIEW OF THE LITERATURE

The first case of osteitis pubis was described by Beer[5] in 1924. This case was observed in 1916 following a simple suprapubic prostatectomy. About three weeks after the operation the patient developed pain over the symphysis and down the adductor muscles. As the suprapubic fistula was slow in closing, Beer believed that a foreign body might have been left in the bladder. However, as a result of conservative treatment, consisting of local heat, sitz baths, baking and massage, not only did the wound heal but all other symptoms disappeared as well, making it evident that the condition was due to "periostitis of the symphysis and descending rami of pubes following suprapubic operation." In 1928, Beer[6] reviewed the subject and he stated that since his first case there had been "numerous other similar cases" and in the same year he encountered 2 such cases following resection of the bladder for carcinoma.

Despite this relatively high incidence claimed by Beer, the literature during the ensuing two decades contained only occasional case reports of osteitis pubis so that all investigators who attempted a statistical compilation arrived at the conclusion that the condition is extremely rare.

Since 1947, however, an increasing number of articles have made their appearance, enriching the literature on osteitis pubis to no small extent.

A review of all reports published from 1924 until June, 1950, reveals the rather

* Presented at the Fifty-first Annual Meeting, American Roentgen Ray Society, St. Louis, Mo. Sept. 26–29, 1950.

TABLE I

COMPILATION OF CASES OF OSTEITIS PUBIS COLLECTED FROM THE LITERATURE

Year	Author	Cases	Type of Operation (or other cause)	Onset	Treatment	Healed
1924 1928	Beer[5] Beer[6]	6	Suprapubic prostatectomy: 4 Bladder resection for cancer: 2	3–12 weeks	Local heat, sitz baths, massage	
1924	Aschner[2]	1	Suprapubic prostatectomy: 1	3 months	Physiotherapy, baking	4 months
1929	Peirson[33]	1	Suprapubic prostatectomy: 1 (also reported 3 cases of osteomyelitis)	2 months	Curettage plus drainage	11 months
1929	Goldstein and Abeshouse[13]	3	Suprapubic prostatectomy: 3	1–3 months	Curettage, drainage, heat, diathermy	6–10 months
1930	Kretschmer and Sights[22]	1	Suprapubic prostatectomy: 1	3 months	Extended to both ischia	2½ years
1936	Lazarus[24]	3	Suprapubic prostatectomy: 3	3 weeks	Diathermy plus plaster cast	9–12 months
1938	Goldstein and Ferber[14] (new cases)	3	Suprapubic prostatectomy: 3	4–8 weeks	Heat, sitz baths, diathermy	9 mo.–2 yr.
1941	Wheeler[42] incl. case of Twinem	3	Suprapubic cystotomy: 2 Transurethral resection: 1	3–9 weeks		5 mo.–1 yr.
1941	Riaboff[35]	1	Suprapubic prostatectomy: 1	1 month	Died 5 mo. later from pulmonary congestion	Autopsy done
1941	Silver[40]	4	Suprapubic prostatectomy: 4 (1 case had chronic *B. coli* infection)	2–4 weeks	Rest, curettage, plaster spica	6 months
1942	Kleinberg[20]	1	*B. coli* pyelonephritis in woman	1 month	Sulfanilamide, plaster spica	1 year
1945	Muschat[31]	2	Suprapubic prostatectomy: 2	3 weeks	Curettage and roentgen therapy in 1 case; no treatment in second case	4 months
1946	Riches[36]	2	Retropubic prostatectomy: 2			
1946	Cohen[10]	2	Suprapubic prostatectomy: 2	2–3 months	Traction, plaster spica	2 years
1947	Kirz[19]	10	Suprapubic operations: 10	3–6 weeks		
1947	Powell[34]	1	Transurethral resection: 1	6 weeks	Rest, sulfamerazin, vitamins	3 months
1947	Bell[7]	4	Suprapubic prostatectomy: 4	2–3 months	Penicillin	4 months
1947	Goldstein and Rubin[15] (new cases)	4	Suprapubic prostatectomy: 4	2–8 weeks	Roentgen therapy in 3 cases	4 mos.–1 yr.
1948	Shivers and Groom[39]	5	Suprapubic prostatectomy: 4 Perineal prostatectomy: 1			
1948	Rosenberg and Vest[37]	4	Retropubic prostatectomy: 2 Transurethral resection: 2	2–8 weeks	Traction, chemotherapy, vitamins	5–8 months
1949	Hotchkiss, Schoenau and Accettola[17]	4	Suprapubic prostatectomy: 2 Perineal prostatectomy: 2	1–2 months	Penicillin, 1 case also roentgen therapy	4 mo.–1 yr.
1949	LaValle and Hamm[23]	6	Suprapubic prostatectomy: 6	3–7 weeks	Vitamin B complex, diathermy	9 mo.–2 yr.
1949	Pepe, reported by LaValle and Hamm[23]	1	Retropubic prostatectomy: 1		Roentgen therapy after diathermy and vitamin therapy failed	Good response
1949	Bruskewitz[8]	6	Suprapubic prostatectomy: 3 Transurethral resection: 2 Pelvic-uretero lithotomy in a woman: 1	1–9 months	High caloric diet, vitamin B and in 2 cases roentgen therapy	

Table I— continued

Year	Author	Cases	Type of Operation (or other cause)	Onset	Treatment	Healed
1949	Moore[29]	8	Retropubic prostatectomy: 8	2 months	Local heat, antibiotics, vitamin B	
1949	Millin, Macalister and Kelly[28]	6	Retropubic prostatectomy: 6			3 cases mild, 3 cases severe
1949	Abrams, Sedlezky and Stearns[1]	5	Suprapubic prostatectomy: 2 Retropubic prostatectomy: 2 Abdominoperineal resection of cancer of rectum: 1	1–3 months	Vitamin B, and in 3 cases roentgen therapy	1 year
1949	McGinn[27]	1	Ureterolithotomy in a woman: 1	2 months	Penicillin	2 years
1949	Beach[4]	7	Suprapubic prostatectomy: 4 Bladder resection for cancer: 2 Transurethral resection: 1	2 weeks		6 months plus
1949	Lopez Engelking[26]	5	Retropubic prostatectomy: 4 Suprapubic prostatectomy: 1	3–12 weeks	Diathermy, plus large doses of vitamin B_1	
1950	Henderson[16]	5	Retropubic prostatectomy: 4 Suprapubic prostectomy: 1	3–10 weeks	Rest, penicillin, sulfa drugs	4 mo.–1 yr.
1950	Klinefelter[21]	1	Single blow to symphysis in a boy of 16 years	3 weeks	Rest	2 months
	TOTAL	116				

surprising fact that the total number of the cases amounts to 116 (Table 1), 83 of which fall in the short period since 1947.

An analysis of the data contained in Table 1 brings out two facts: (1) there are, especially in the early reports, not infrequent cases classified as osteitis pubis when in fact the patients had a frank osteomyelitis, either arising primarily in the pubic bones or being transmitted secondarily from a purulent infection of Retzius' space or one of the prevesical spaces; and (2) the more recent sudden increase in the number of cases must be attributed to a better diagnostic evaluation and especially an intensified search for osteitis pubis as a potential postoperative complication in a large series of all types of urologic surgery.

(1) The clinical picture of frank osteomyelitis of the pubic bones has long been known. Dinan[11] reviewed the literature from 1883 to 1937 and was able to collect 34 cases of primary infection; the number of cases of secondary infection through extension from the neighboring structures was considerably greater. In summarizing the histories and physical signs of the collected cases, Dinan listed several characteristics of frank osteomyelitis pubis which are remarkably similar to those observed in osteitis pubis. Among these are (a) a history of direct trauma to the pubis, e.g., 2 cases occurred in cavalrymen who had been thrown against the pommel of their saddles, and 1 in a girl who had fallen astride the edge of a table; (b) a history of indirect trauma to the knee, leg or even foot; (c) a history of some previous focus of infection; (d) severe pain in the pubic region, usually shooting down the inner aspect of the thigh; and (e) difficulty or inability to walk. It is therefore understandable that milder or somewhat unusual cases of osteomyelitis should have been considered as being cases of osteitis pubis and so reported in several of the early publications. Others were inadvertently included later by the subsequent reviewers of the subject. The line of separation, as we now know it, is formed by the suppurative process which is usually absent in

osteitis pubis and constitutes the dominating element in the osteomyelitis leading to bone destruction with sequestration, retropubic or pelvic abscesses and severe toxemia. As indicated by Dinan, the mortality rate in the cases of frank osteomyelitis pubis amounts to approximately 25 per cent.

Based on these criteria of Dinan, several cases may be omitted from the collective series of osteitis pubis usually listed in the literature since, in fact, they represent instances of frank osteomyelitis, mostly secondary to prevesical or pelvic cellulitis. Thus Schulte[38] reported a patient who, following one stage prostatectomy, developed an abscess of Retzius' space, osteomyelitis pubis and sepsis with death at the end of the sixth week. Moschowitz[30] described 2 cases. The first was that of a machinist, forty-nine years of age, who by sitting accidentally on the point of an oil can suffered a perineal puncture followed by a large pelvic abscess and osteomyelitis with sequestration of the pubic bone. The second was that of a man afflicted with a prostatic abscess which later extended into the pelvis and around the rectum, producing an osteomyelitis of the ascending ramus of the left pubic bone with the formation of a large sequestrum.

The 1 patient recorded by Chute[9] died as a result of septicemia associated with osteomyelitis pubis and an abscess of Retzius' space seventy-one days after suprapubic prostatectomy. Of the 4 cases published by Peirson,[33] only the first case exhibited the typical picture of osteitis pubis, although even in this case some yellow pus was obtained when the apparently healed suprapubic wound was reopened and the incision was carried through a mass of infected tissue down to the pubic bone. The second case was the one described by Chute.[9] The third case was that of a young man, twenty-five years of age, who had been carrying heavy boxes, supporting them partly on his lower abdomen and who, seventeen months later, after two episodes of pain ten months apart, developed an osteomyelitis pubis secondary to a large abscess in the prevesical space which was successfully drained. The fourth case, which is repeatedly referred to in the literature as an example of osteitis pubis following hernia operation, also represented a purulent infection of long standing and great persistence. A bilateral herniorrhaphy was performed eight years previously and an infected sinus resulted on one side healing only after a period of five years. Two and one-half years later a swelling developed at the site of the old sinus. This soon broke down and began to drain pus and urine. It was the opinion of Peirson that the urinary fistula might have developed as a result of a prevesical abscess coming from the osteochondritis of the pubis and having ruptured the urethra. The 2 cases described by Barnes[3] may also be considered as examples of osteomyelitis rather than osteitis pubis. The author himself classified the condition as osteochondritis. In both cases the destruction of the symphysis and pubic bones was associated with the presence of pus in the space of Retzius. In the first case the abscess developed slowly and was drained ten months after a suprapubic prostatectomy had been performed. In the second case the infection occurred after perineal prostatectomy and, following several unsuccessful auxiliary operations, an abscess of the prevesical space was finally discovered four months later and drained. Healing resulted in both instances within four to six weeks after the drainage. Likewise, the 2 cases attributed to Wilensky[43] and which are cited as instances of osteitis pubis secondary to symphysiectomy in women are, in fact, cases of osteomyelitis of the pubis. One of these cases was published originally by Jentzer[18] and the other by Söderlund.[41] In Jentzer's patient a symphysiectomy was performed during difficult delivery, and two weeks later severe pain developed in the region of the pubis, associated with profuse discharge from the operative wound. The patient had a gait that resembled the one usually seen in

bilateral congenital dislocation of the hip. Roentgenograms made five months after the operation revealed separation of the symphysis and destruction of the pubic bone with sequestration. Surgical intervention led to full recovery. In Söderlund's patient an apparently uncomplicated labor was followed by vaginal discharge and pain in the pubic region lasting for one and one-half years. Eventually a sinus was discovered communicating with the os pubis. After sequestrotomy the patient promptly recovered.

One could cite additional cases which are probably instances of osteomyelitis of a milder degree but because of the close similarity in clinical behavior were included in the group of osteitis pubis. If all of the doubtful cases were to be excluded, the number of cases of true osteitis pubis reported from 1924 to 1946 would fall even lower than the figure of 33 indicated in Table I. With the exception of the case of Kleinberg[20] they occurred exclusively following operations upon the urinary bladder and prostate, in particular following suprapubic prostatectomy. The case of Kleinberg represented an acute pyelonephritis of colon bacillus origin in a fifty-three year old woman who, about one month after the onset of her illness, developed the typical picture of osteitis pubis. Following sulfanilamide therapy and immobilization of the pelvis the condition completely cleared up.

(2) As already stated, the total number of cases of osteitis pubis reported since 1947 amounts to 83 but it is probable that the number is considerably higher. During this period comprehensive statistical studies of large series of all types of prostatectomies were made and the relationship of osteitis pubis to various surgical techniques analyzed. It soon became evident that the condition, far from being a postoperative complication of only the suprapubic or transvesical approach, is also observed following retropubic and perineal prostatectomy, transurethral resection, partial cystectomy, pelvic ureterolithotomy, etc. The distribution of osteitis pubis in relation to various types of urologic operations is shown in Table II.

Table II

INCIDENCE OF OSTEITIS PUBIS AS AN AFTERMATH OF VARIOUS UROLOGIC OPERATIONS

Type of operation (or other cause)	Cases
Suprapubic prostatectomy	68
Retropubic prostatectomy	29
Transurethral resection	7
Partial cystectomy	4
Perineal prostatectomy	3
Pelvic ureterolithotomy	2
Abdominoperineal resection of sigmoid	1
Pyelonephritis	1
Single external trauma to symphysis	1
TOTAL CASES	116

SYMPTOMS

The outstanding symptom in osteitis pubis is excruciating pain. Undoubtedly there are many mild cases in which the disease escapes detection or is diagnosed accidentally when a roentgenogram of the pelvis is made for some other reason. In those patients, however, who present themselves with a fully developed syndrome, pain completely dominates the symptom mosaic.

The clinical course is quite typical. The patient has returned to his home after an apparently successful urologic operation which had been performed three to eight weeks previously. The operative wound is healed, the urinary habits have become almost normal and he may have resumed his former occupation. Then, with a striking suddenness, pain develops in the region of the symphysis pubis. Within a few days this pain extends to the crotches, Scarpa's triangle and inner thighs and the patient is forced to lie down. At this stage any movement of the trunk and especially of the thighs provokes spastic, almost tetanic contractions of the muscles. Any attempt of the patient to get in or out of bed, or

TABLE III

RELATIONSHIP BETWEEN THE FUNCTION AND BONY ATTACHMENT OF MUSCLES IN OSTEITIS PUBIS

Muscle	Insertion	Function
(1) Rectus group (a) rectus abdominis	Crest and symphysis pubis	Flexor of the pelvis
(b) pyramidalis	Upper border of symphysis and pubic body	Tensor of linea alba
(2) Adductor group (a) adductor longus	Anterior surface of the body and superior ramus of the pubic bone	Adductor, flexor and outward rotator of the thigh
(b) adductor brevis	Anterior surface of the body and inferior ramus of the pubic bone	Adductor, flexor and outward rotator of the thigh
(c) adductor magnus	Inferior pubic and ischial rami	Adductor of the thigh
(d) gracilis	Anterior surface of the body and inferior ramus of the pubic bone	Flexor of the thigh; adductor and inward rotator of the leg
(e) pectineus	Iliopectineal line of the pubis	Adductor and flexor of the thigh
(3) Hamstring group (a) biceps femoris	Lower and inner facet of tuber ischii	Extensors of the thigh; flexors and rotators of the leg
(b) semitendinosus	Lower and inner facet of tuber ischii	
(c) semimembranosus	Outer facet of tuber ischii	
(4) Obturator group (a) obturator externus	Obturator margin of pubic and ischial rami	Outward rotators of the thigh
(b) obturator internus	Inner surface of pubic and ischial rami	
(5) Perineal group (a) compressor urethrae	Inner surface of inferior pubic ramus	Sphincter of urethra
(b) levator ani	Posterior surface of the body of the pubis and spine of the ischium	Elevator of the pelvic floor

even to turn from side to side leads to uncontrollable fear and agony.

All authors agree with the original contention of Beer[5] that this excruciating pain is due to the pull of the muscles on their attachments to the extremely sensitive diseased bone. As the osteitis advances from the symphysis across the pubic rami toward the ischial tuberosities, the attachments of additional groups of muscles become affected, thus accounting for the rapid progress in the disability of the patient and the corresponding increase of his pain. Occasionally, the process may remain localized to the attachments of the recti muscles but in the majority of instances the attachments of the adductor, hamstring and some of the flexor muscles are involved as well. If the osteitis pubis also extends to the zones which form the sites of attach-

ments of the obturator, compressor urethrae and levator ani muscles a marked bladder spasm usually associated with rectal tenesmus further aggravates the already severe symptom complex. The relationship which exists between the function of the major group of muscles and their insertion into the affected bones is shown in Table III.

The duration of acute pain varies. In the milder cases it may last only three to four weeks but it is more likely that the time of full recovery will extend over a period of four to twelve months. Even after the original pain at the attachment of the muscles has subsided and the patient has become ambulant, lingering complaints may persist for many months. In some cases the patients may walk with a gait resembling that seen in congenital dislocation of both hips; in others, especially if the ischial tuberosities have been involved, they may have considerable difficulty in changing from the standing to the sitting or recumbent positions, and vice versa; and in still others, they may have to move about with the aid of crutches or a cane due to the severe atrophy of the muscles that followed the osteitis pubis.

PHYSICAL SIGNS

The physical signs are few. At the beginning there is slight to moderate swelling over the symphysis with exquisite tenderness on palpation. There are no signs of local inflammation and there is no evidence of accumulation of pus. The temperature and pulse usually remain normal or are only slightly elevated. When the process extends to the pubic rami and ischia, tenderness on palpation or pressure is present also over these regions. At no time is there evidence of swelling of the inguinal lymph nodes, as found not infrequently in osteomyelitis of the pubic bones.

The operative wound is usually healed. In a few instances a small sinus may persist at the lower end of the incision showing healthy granulation tissue. On probing the sinus, bare bone may be felt but suppuration is conspicuously absent.

During the acute stage, any active or passive motion involving the functions of the muscles listed in Table III causes severe pain. There is usually a hyperesthesia of the inner aspects of the thighs corresponding to the cutaneous distribution of the obturator nerve.

In the late stages one may palpate some thickening with irregularity of the pubic bones and ischia due to hypertrophic bone deposits during the period of restoration. There may also be definite atrophy of the muscles of the thigh confined mainly to the adductor group.

ROENTGENOGRAPHIC FINDINGS

Most cases of osteitis pubis exhibit rather characteristic roentgenographic changes. A certain interval must elapse, however, before these changes become manifest. Once their presence has been confirmed, a progressive destruction of the bone is observed, reaching a self-limiting peak. Then the process is reversed and a gradual regeneration of the bone takes place. Accordingly, one may distinguish between changes incident to three stages of development.

(1) *Prodromal Stage.* This stage usually lags one to seven weeks behind the onset of the clinical symptoms and four to twelve weeks behind the onset of the disease or the time of the operation. The roentgenographic examination usually remains negative. In a few instances there may be evidence of a slight fraying of the corners of the symphysis or a faint fuzziness of the rami of the pubic bones.

(2) *Destructive Stage.* The first signs of destruction appear most commonly in the medial portion of the pubic corpora extending gradually into the pubic rami and towards the ischial tuberosities. The roentgenograms in this stage show a very definite roughening and fraying of the periosteum with woolly or moth-eaten rarefaction of the affected portions of the bone. This is especially pronounced in the region of the symphysis and, if associated with absorp-

tion of the cartilage, may create the impression of a separation of the symphysis. The destructive process is followed by marked decalcification which may become the outstanding finding on subsequent roentgenograms. However, even in the severest cases no sequestration of the bone is observed, although, occasionally, when the periosteum is lifted together with the underlying bone by the muscle attachments, the image of a false sequestrum may be encountered.

(3) *Regenerative Stage.* After a self-limited period of two to eight months, a slow recalcification sets in, leading to a full restoration of the bone within another six to twelve months. In the early part of this stage one may find on the roentgenograms areas of rarefaction intermingled with zones of beginning re-ossification. As time goes on, the osteoporosis completely disappears and solid bone with normal trabecular arrangement supervenes. The symphysis may remain widened but most frequently it is markedly narrowed and ankylosed. In the completely healed cases roentgenographic examination reveals slight osteosclerosis of the formerly affected parts of the bone with a very dense symphysis and numerous spurs as a result of the periosteal new bone formation at the sites of the muscle attachments. These spurs are especially pronounced along the inferior pubic rami and on the ischial tuberosities.

DIFFERENTIAL DIAGNOSIS

The most important lesion from the point of view of differential diagnosis of osteitis pubis is the frank osteomyelitis. Dinan[11] has given a comprehensive description of the main features of osteomyelitis pubis and these have already been discussed in the section on "Review of the Literature." The two outstanding criteria of differentiation are fever and sequestration, both of which are present in osteomyelitis and absent in osteitis. There are a few cases of osteitis, however, which were described in the literature as having developed into frank osteomyelitis.

Another lesion with which osteitis pubis has been confused, especially in the early days, is metastatic malignancy. Since the preceding operation was usually performed for removal of an enlarged prostatic gland, a primary carcinoma of the prostate was surmised not infrequently despite a negative histopathologic report and notwithstanding the fact that metastases from carcinoma of the prostate produce osteoblastic rather than osteolytic changes of the bone. In the light of the present-day knowledge this differentiation, however, should not be difficult.

Rarer lesions to be considered are tuberculosis and syphilis of the pubic bones.

When the osteitis pubis is associated with a residual sinus, roentgenography following injection of opaque medium may prove helpful.

PROGNOSIS

Uncomplicated osteitis pubis is a disease with a good final prognosis. There are 5 patients cited in the literature who presumably died from the condition but a restudy of these cases shows that in 4 there was evidence of severe purulent infection of the space of Retzius and other pelvic structures with terminal septicemia. The fifth patient, reported by Riaboff,[35] died as a result of pulmonary complication.

The period of full disability varies from three to six months, and is followed by a period of a limited incapacity lasting from six to twelve months. After two years there is a complete recovery without residual symptoms in practically every case.

ETIOLOGY AND PATHOGENESIS

The etiology of osteitis pubis has been the subject of considerable discussion and much confusion. The fact that the first observations were made on patients whose bladders had been opened induced Beer to regard the condition primarily as a postoperative complication. He expressed the opinion that it is the result of a mild infection but "whether the infection develops in the periosteum as a result of injury to the periosteum by traction on the attached

rectus muscles, or whether it is due to direct bruising of the periosteum by drainage tubes in the bladder, is difficult to say." Beer rather inclined to the former as the more likely explanation.

The issue became considerably obscured when in subsequent publications[18,20,33,41,43] other types of operations or lesions were reported as producing the syndrome, such as herniorrhaphy, symphysiotomy, perforating perineal injuries, direct blow to the symphysis, pyelonephritis, etc. This, together with the relative paucity of cases recorded following urinary bladder procedures during the same period, made it appear as though osteitis pubis were a rare disease caused by various agents. If, however, as shown in the historical review, the cases of frank osteomyelitis of the pubic bones or pelvic girdle are carefully eliminated, one cannot escape the impression that—to use the words of Beach[4]—"osteitis pubis is really sponsored by urologic surgery." The marked increase in the number of cases during recent years following all varieties of prostatectomies and other urinary bladder procedures only serves to further substantiate this impression.

There are at least five theories of the etiology of osteitis pubis.

(1) *Theory of infection of the traumatized os pubis.* Nearly all partisans of this theory[5,24,13,14,15,31,19,16,37] assume that two prerequisites are necessary to initiate the process: (a) injury to the periosteum of the os pubis or its nutrient vessels, and (b) spill of urine or septic material on the traumatized bone.

(a) The injury to the periosteum may result from avulsion of the fibers of the recti muscles at their point of insertion, from tearing of the pubic attachment of the transversalis fascia or of the puboprostatic ligaments, from pressure of the retractors or drainage tubes, from puncture of the needle used for local anesthesia and from interference with the nutritional vessels.

According to Beach,[4] however, a direct extension of the septic material through denuded areas of the periosteum is unlikely. In his estimation the important factor is injury to the prostatic capsule with septic spill. Anatomically, the prostate has a true capsule and a false capsule, the latter being formed by a layer of visceral pelvic fascia common to the bladder and prostate alike. Both capsules are densely adherent at the pubic surface. If this adherency is torn, as sometimes happens in suprapubic and transurethral prostatectomy, or if the two capsules are deliberately opened from the front, as is the case in retropubic prostatectomy, and leakage of the urine occurs, this will accumulate, for anatomic reasons, in a retropubic niche which overlies both pubic nutrient foramina. According to Beach,[4] this assumption receives confirmation through the fact that the condition is extremely rare in the female where the fascial planes are modified and the lymphatic drainage occurs chiefly via the broad ligaments.

(b) The mode and type of infection of the traumatized, or devitalized bone have been explained in various ways. Most authors agree that the infection leads to a low grade inflammation and that sequestration is absent even in the severe cases. However, there is considerable divergence of opinion as to which bacteria are culpable. A review of the literature reveals in this respect that nearly all of the microorganisms ordinarily found in infected urine have been suggested as pathogenic agents with the addition that the urine itself may act as irritant.

Kleinberg[20] observed a case of osteitis pubis secondary to colon bacillus pyelonephritis in a woman. Powell[34] reported a patient who developed osteitis pubis as a result of chronic infection due to *B. proteus* following suprapubic cystectomy. In the 5 cases described by Abrams, Sedlezky and Stearns[1] the urine cultures produced *Pseudomonas aeruginosa* although the significance of this finding was not established.

A very interesting statement was made recently by Millin, Macalister and Kelly.[28] These authors, in seeking an explanation for the sudden increase in the number of cases following all varieties of prostate surgery since 1946, whereas Millin himself

could not recall a single instance in eighteen years of urologic surgery prior to that date, thought that perhaps the new therapeutic agents such as the sulfa drugs and the antibiotics could be incriminated. After a discussion with Bell[7] who likewise noted a marked increase in the incidence of osteitis pubis in a short series of Harris prostatectomies in 1948, they arrived at the conclusion that the cause might be prompt healing of the superficial wound with locking up of *Pseudomonas pyocyanea* and other resistant organisms. Accordingly, they have discontinued the routine use of penicillin in urologic surgery, restricting it to only those cases in which it is absolutely necessary.

(2) *Theory of acute atrophy or aseptic necrosis of the os pubis.* This theory was advanced by Wheeler[42] in 1941, after he was unable to reproduce the condition experimentally in rabbits by a combination of trauma and infection. Wheeler performed the following series of experiments: (a) injection of sterile urine under the periosteum of the pubis; (b) injection of urine plus cultures of hemolytic *Staphylococcus aureus* under the periosteum; (c) injection of mixed cultures under denuded periosteum of the pubis, bladder opened and space of Retzius traumatized; (d) suturing foreign body under the periosteum of the pubis with injection of rabbit urine and staphylococcus culture, keeping spaces of Retzius and bladder open by manipulation twice a week; (e) injection of nutrient artery of the femur with the same culture. An osteomyelitis with severe bone necrosis resulted in (e) but in all other experiments the animals, sacrificed within three to twelve weeks, showed normal periosteum and bone.

According to Wheeler, there are also certain clinical and roentgenologic features which would seem to indicate that osteitis pubis is not the result of infection. These are: (a) an extensive decalcification of a large area of bone, i.e., the pubic and ischial rami, is at variance with the behavior of periostitis elsewhere in the body; moreover, it is inconceivable that an infection would jump over the cartilaginous symphysis extending to an equal distance bilaterally; (b) healing in osteitis pubis leads to normal trabecular conformation of bone whereas periostitis is characterized by deposition of new bone with destruction of the trabecular conformation and osteomyelitis is conspicuous by sequestra formation with destruction of the trabecular conformation.

Based on the experimental results and the clinical roentgenologic considerations, Wheeler arrived at the conclusion that, osteitis pubis represents an acute atrophy of the bone similar to Sudeck's atrophy observed in conjunction with trauma of the small bones of the hands and feet and more rarely of other skeletal bones including the spine, knees, shoulders, etc. The similarity is reflected in the following features of Sudeck's atrophy: (a) it follows injury to the nerve supply (trophoneurosis) of the affected part by operation, irritation or other trauma; (b) it is associated with extreme pain on motion and tenderness on pressure; (c) there is very severe muscle spasm; (d) there is mottled rarefaction of the affected bone on the roentgenograms; (e) in the acute atrophic stage, pieces of periosteum are separated from the bone; and (f) the condition is self limited requiring three months to two years to heal.

The theory of Wheeler has received considerable support from two sources. The one is that of Riaboff[35] who performed the only known autopsy in a man afflicted with osteitis pubis. The patient died as a result of pulmonary complication four and one-half months after a two-stage suprapubic prostatectomy. In describing the histopathologic findings, Riaboff states that there was no evidence of inflammation but rather a diminution in the number and thickness of the bony lamellae. There was a uniform loss of bony substance and not merely a depletion of the mineral salts of the bone. The unaltered architecture of the bone was easily recognized. The second source is that of Klinefelter[21] who observed a typical osteitis pubis which occurred in a boy, aged sixteen, without preceding operation, following a single direct blow over

the pubis. The first symptoms appeared within three weeks after the injury. There was a slight elevation of temperature with some local heat and marked tenderness on pressure but no fluctuation characteristic of pus. After a bed rest of three weeks' duration the symptoms subsided; however, it took nearly two years before the roentgenologic examination revealed a complete restoration of the bony contours of the pubis.

The theory of similarity to Sudeck's atrophy was endorsed by Cohen,[10] Bruskewitz,[8] and others.

Among the less popular theories of the etiology of osteitis pubis one may mention: (3) extension by continuity from infection of the space of Retzius or of other prevesical spaces (Kleinberg[20]); (4) extension by lymphatic spread from a low grade pelvic cellulitis (Bell[7]) and (5) injury by the boomerang needle in retropubic prostatectomy according to the technique of Millin (Henderson[16]).

ROENTGEN THERAPY

Since osteitis pubis is "sponsored" almost entirely by urologic surgery, considerable attention has been paid more recently to various preventive measures. As Beach[4] states, "with this malady an ounce of prevention is worth a pound of cure."

The preventive measures studied include suggestions of operative techniques, avoidance of preoperative trauma by indwelling catheters and unnecessary instrumentation, avoidance of tight packing of the prostatic cavity, careful elimination whenever possible of a septic spill and, above all, the institution of an effectual drainage. A great deal is made of the fact that osteitis pubis is rarely observed following uncomplicated perineal prostatectomy in which operation the dependent drainage meets the clinical and anatomic requirements in a most satisfactory way.

Once osteitis pubis has set in, the aim of any therapeutic effort must be twofold: (a) alleviation of the severe clinical symptoms, in particular of the excruciating pain, and (b) shortening of the clinical course of the self-limited disease. This can be best accomplished by the use of deep roentgen therapy with or without other auxiliary methods.

Goldstein and Rubin[15] in 1947 were the first to report "excellent results" in the relief of pain by deep roentgen therapy in 4 cases. Three of these were treated between 1941 and 1946 by Ostro and the fourth in 1946 by Christie, Groover and Merritt. The first case had traction for about one month without much benefit and a series of deep roentgen therapy resulted in improvement. In the second case the relief from deep roentgen therapy was even more rapid after immobilization by plaster cast over a period of several months had failed. The third case received deep roentgen therapy as the first choice followed soon by relief of pain and adductor spasm. In the fourth case a bedridden patient was made to walk after a course of eight roentgen treatments given in ten weeks. The total dose in the 3 cases treated by Ostro varied between 4,435 and 6,668 r divided over two to three fields and distributed over a period of one to three months. The factors were: 200 kv., with a composite filter equivalent to 2 mm. Cu half-value layer, 20 ma., 50 cm. skin target distance and 10 by 10 cm. or 15 by 15 cm. fields.

LaValle and Hamm,[23] in reporting 6 cases, state that 1 of their patients who developed osteitis pubis following retropubic prostatectomy did not show the expected improvement to vitamin B complex whereupon Pepe administered a course of deep roentgen therapy. A good effect was obtained. Therefore, they believe that all refractory cases to vitamin B complex should receive deep roentgen therapy.

Bruskewitz[8] mentions that deep roentgen therapy was given in association with diathermy in 2 of his 3 cases. In 1 of the cases exposed to roentgen radiation the immediate progress had been much faster than in the 2 other cases.

Abrams, Sedlezky and Stearns[1] applied deep roentgen therapy in 3 out of 5 cases which were generally treated with vitamin B_1. The roentgen therapy was beneficial

in 1 case but ineffective in the other 2 cases.

The most commonly advocated auxiliary measures are: (1) diathermy and heat; (2) large daily and total doses of vitamin B_1; (3) rest and immobilization in the severe cases by Buck's traction or plaster spicas; (4) drugs for the relief of spasms, such as combination of prostigmine (1 cc. of 1:2,000 solution) and atropine (0.43 mg.) every twelve hours, as recommended by Rosenberg and Vest;[37] (5) chemotherapy, consisting of antibiotics and sulfa drugs, although, unless there is local suppuration or some other infection present, the beneficial effect of these is questionable; and (6) sedation if the severe pain is not controlled by other means.

In the early days incision and curettement, and even resection, of the affected bone was recommended but surgical procedures are reserved at the present for the very rare instances in which a retropubic or pelvic abscess complicates the picture of osteitis pubis.

During the past five years 4 cases of osteitis pubis were observed at Harper Hospital all of which were treated by deep roentgen therapy.

CASE 1. H. W., male, aged forty-three. Admitted to Harper Hospital on February 24, 1945, for deep roentgen therapy with a diagnosis of metastasis to the pubic bones from a presumed primary carcinoma of the prostate.

October 1, 1944. Suprapubic prostatectomy was performed at another institution for benign hypertrophy. The histopathologic examination showed no sign of malignant change.

November 16, 1944. Discharged after a somewhat prolonged convalescence. The operative wound was healed.

November 26, 1944. The patient suddenly developed pain in the region of the symphysis. Within a few days this became so severe that he had to go to bed. He was unable to sit up or lie down without help and even turning from side to side caused agonizing spastic contractions of the muscles of the thigh. He continued to stay in bed at home.

January 1, 1945. The patient developed intensive jaundice.

From January 10 to February 7, 1945, he was hospitalized at two different institutions and treated symptomatically for the excruciating pain and the jaundice. Roentgenograms of the pelvis revealed areas of rarefaction of the pubic bones which were interpreted as being due to metastatic malignancy. It was assumed that despite the negative histopathologic report a small focus of carcinoma may have been present in the prostate, representing the primary lesion. The jaundice was attributed to probable metastasis of the liver.

February 7, 1945. The patient was discharged to his home where he continued to remain bedridden.

February 24, 1945. Admitted to Harper Hospital for palliative roentgen therapy. The outstanding findings at this time were: inability of the patient to turn from side to side or sit up; marked tenderness over the symphysis and especially in the regions of the ischial tuberosities; moderate jaundice without apparent enlargement of the liver; poor concentration of the dye on cholecystography without visualization of gallstones; moderate anemia with cachexia; definite increase of alkaline phosphatase in the blood and evidence of Bence-Jones bodies in the urine. In view of this latter finding the possibility of multiple myeloma was also entertained in the differential diagnosis.

February 26, 1945. Roentgenograms of the pelvis (Fig. 1, *A*) revealed demineralization and rarefaction taking place in the pubic bones and ischial tuberosities and there also was an area of rarefaction in the left sacrum at the sacroiliac articulation. Roentgenograms of the entire spine, thoracic cage, skull and long bones remained negative.

March 3, 1945. Additional roentgenograms of the pelvis (Fig. 1, *B*) showed what appeared to be a slight extension of the process.

From March 3 to 8, 1945, the patient received a first series of deep roentgen therapy associated with intravenous colloidal lead therapy. The factors of the roentgen irradiation were: 200 kv., 1 mm. Cu, half-value layer of 1.9 mm. Cu, 20 ma., 15 r per minute, and 50 cm. skin target distance. It was impossible to place the patient in any other position except on his back. For this reason, and since palliation was the sole aim, a single portal (20 by 20 cm.) was used which was directed through the pelvis anteriorly. The dosage was: March 3, 1945, 120 mg. colloidal lead orthophosphate injected intravenously; March 6, 1945, 300 r (in air); March 7, 1945, 300 r (in air) and March 8, 1945, 300 r (in air).

March 10, 1945. Discharged.

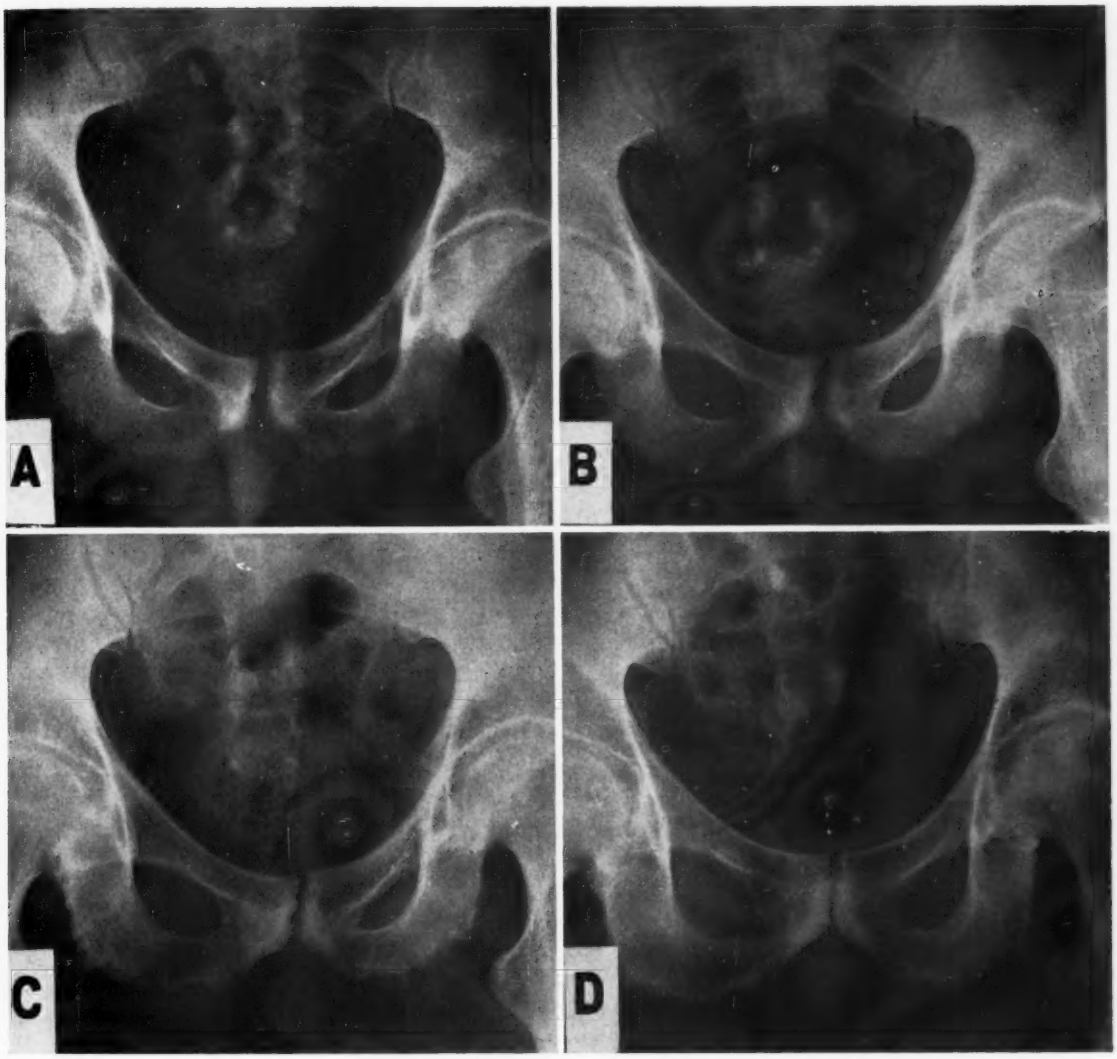

Fig. 1. Case 1. Osteitis pubis erroneously diagnosed as metastatic carcinoma of prostate. (*A*) Before treatment. Roentgen appearance three months after onset (nearly five months after suprapubic prostatectomy), (*B*) one week, (*C*) six months and (*D*) five and one-half years later.

June 3, 1945. Readmitted to Harper Hospital. There was a surprisingly good response. The pain completely disappeared within about one month following the treatment and the patient was able to be up and around without difficulty. He had gained 17 lbs. in weight.

At the time of re-examination he was asymptomatic. The alkaline phosphatase was normal and no Bence-Jones bodies could be demonstrated in the urine. The jaundice had cleared up.

Checkup roentgenograms of the pelvis showed very definite improvement with considerable re-ossification in the formerly destroyed areas.

From June 5 to 9, 1945, a second series of roentgen therapy was given, again associated with intravenous colloidal lead orthophosphate therapy. The pelvis at this time was cross-fired through three fields, anterior, left posterior oblique, and right posterior oblique. The individual dose amounted to 540 r (in air) per field, corresponding to a full erythema dose.

June 10, 1945. Discharged.

September 7, 1945. Re-examination revealed the patient to be in excellent condition. Roentgenograms of the pelvis (Fig. 1, *C*) showed complete re-ossification of the formerly destroyed areas with multiple spurs of irregular size at the sites of muscle insertions. There was

narrowing of the formerly separated symphysis with moderate sclerosis of the adjacent portions of the bodies of the pubic bones.

July 2, 1950. Roentgenograms of the pelvis (Fig. 1, *D*) showed complete re-establishment of the normal bone structure. Some of the spurs had reabsorbed. There was good union of the symphysis with moderate sclerosis of the adjacent pubic bones.

Comment. In retrospect, there can be no doubt that this patient had an osteitis pubis following suprapubic prostatectomy, complicated by catarrhal jaundice. Although the roentgen technique was somewhat different from that used in the later cases, a surprisingly prompt response was obtained from the irradiation.

CASE II. J. C., male, aged fifty-six.

In November, 1948, the patient was involved in a truck accident and was hit in the lumbar region by a milk case. Three days later he noted onset of muscle spasm in the left leg, followed by a similar condition in the right leg. There was severe pain in the lower back.

January 30, 1949. Patient admitted to Harper Hospital with a questionable injury to lower spine. Preliminary roentgen study by means of myelography revealed complete obstruction to the downward flow of pantopaque at the level of the disc between the fourth and fifth lumbar vertebrae.

February 1, 1949. A laminectomy was performed and a firm mass 1.5 by 2 by 2 cm., which was pressing on the caudal nerves, was removed. On microscopic examination the mass proved to consist of fibrocartilage and connective tissue.

For nearly a year prior to his admission the patient also had urinary symptoms due to a hypertrophy of the prostatic gland.

February 21, 1949. A suprapubic prostatectomy was performed without complications. The histopathologic report was that of benign hypertrophy of the prostate; there was no evidence of malignancy. The operative wound healed satisfactorily.

March 31, 1949. Discharged in good condition.

April 6, 1949. The patient rather suddenly developed severe pain in the region of the symphysis followed soon by difficulty in walking. He was unable to spread his legs apart, had to be helped when sitting down or getting up.

April 8, 1949. Roentgenograms of the pelvis (Fig. 2, *A*) demonstrated moderate osteoporosis of the pubic bones with separation of the symphysis and a slight rarefaction along the upper margins of the pubic bones. This rarefaction had not been present in the earlier myelograms. A diagnosis of osteitis pubis was made and roentgen therapy recommended.

April 8, 1949. First roentgen treatment. A dose of 130 r (in air) was given over the pelvis anteriorly through a field 20 by 20 cm., with 200 kv., 1 mm Cu, half-value layer of 1.9 mm. Cu, at a rate of 13 r per minute, and a skin target distance of 50 cm.

April 29, 1949. The tenderness over the symphysis was less but at this time the patient complained of severe pain in the crotches and especially in the region of the ischial tuberosities. Roentgen study (Fig. 2, *B*) showed a definite extension of the process. The decalcification was more pronounced and there was now mottled rarefaction demonstrable along the lower margins of the inferior pubic rami on both sides, and to a lesser extent in both ischial tuberosities. For this reason, it was decided to repeat the irradiation by using two contralateral fields for the purpose of crossfiring.

April 29, 1950. Second roentgen treatment. A dose of 130 r (in air) was administered over the pelvis anteriorly and posteriorly, the factors otherwise remaining the same as for the first exposure.

This treatment was repeated on May 20, June 24, August 5, September 23 and November 10, 1949, and February 8 and May 9, 1950. There was gradual improvement of the symptoms and the patient returned to work in about five months.

May 13, 1950. Roentgen study (Fig. 2, *C*) revealed complete recalcification of the osseous structures. There was marked sclerosis of the bodies of the pubic bones associated with definite narrowing of the symphysis. There were multiple osseous excrescences at the sites of the muscular insertions on the pubic bones and both ischia.

August 24, 1950. Roentgen study (Fig. 2, *D*) demonstrated the same changes as observed on May 13, 1950, but, in addition, there was further increase in the sclerosis of the pubic bones with bridging across the upper margin of the symphysis.

CASE III. H. C., male, aged sixty. Admitted to Harper Hospital on October 17, 1949. Five weeks previously the patient had a suprapubic

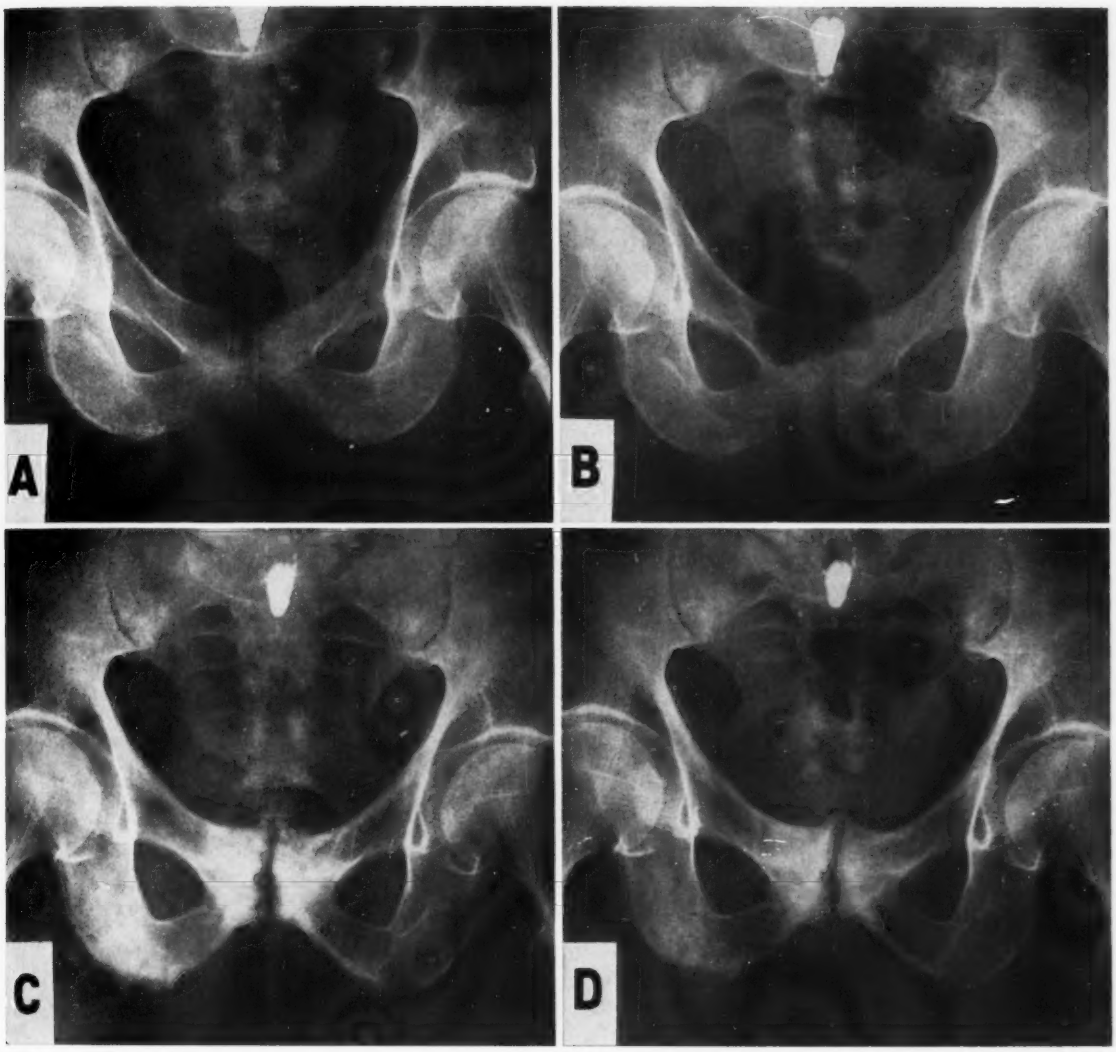

Fig. 2. Case II. Osteitis pubis. (*A*) Before treatment (six weeks after suprapubic prostatectomy), (*B*) three weeks, (*C*) one year and (*D*) one and one-half years later.

prostatectomy performed in another hospital. The histopathologic examination revealed a benign hypertrophy of the prostate. The operative wound healed without complication. Four weeks after the operation the patient was seized with severe pain in the pubic region.

October 17, 1949. Examination revealed the typical symptom complex of osteitis pubis. The patient was completely incapacitated and was unable to sit up or turn from side to side.

Roentgenograms of the pelvis showed a slight widening of the symphysis pubis with a fraying of the periosteum along the upper border of the symphysis and some rarefaction in the adjacent portions of the corpora pubis (Fig. 3, *A*).

October 17 to 18, 1949. First roentgen therapy. A dose of 130 r (in air) was given over the pelvis anteriorly and posteriorly through a field 20 by 20 cm., with 200 kv., 1 mm. Cu, half-value layer of 1.9 mm. Cu, at a rate of 13 r per minute and a skin target distance of 50 cm.

October 19, 1949. Discharged.

December 1, 1949. The patient returned in an ambulatory condition. His pain was much improved. Roentgenograms of the pelvis, however, revealed definite advance of the osteitis pubis (Fig. 3, *B*). The widening of the symphysis pubis had increased and the rarefaction had extended into the pubic rami, although the process as a whole appeared somewhat milder than observed in the average case.

A second roentgen treatment was given by using the same technique.

The patient continued to make rapid im-

provement and after two additional treatments on January 10 and March 7, 1950, he had completely recovered.

March 7, 1950. Roentgenograms of the pelvis showed practically normal architecture of the bone without the usual spur formations. The width of the symphysis pubis was still increased (Fig. 3, *C*).

September 11, 1950. Checkup roentgenograms of the pelvis revealed the same appearance as on March 7, 1950, except that there was now definite sclerosis in the mesial parts of the corpora pubis with slight narrowing of the widened symphysis (Fig. 3, *D*).

CASE IV. W. H. McK., male, aged fifty-one.

January 30, 1943. Admitted to Harper Hospital with progressive urinary symptoms of about one year's duration. A diagnosis of advanced carcinoma of the left half of the bladder was made.

February 6, 1943. A suprapubic cystotomy was done. The neoplasm involved the entire left half and the dome of the bladder. There was marked fixation and it was assumed that the lesion had extended into the neighboring structures. Several pieces of friable tissue were removed for biopsy. The histopathologic report was that of advanced medullary carcinoma.

The lesion was considered inoperable and therefore interstitial gamma therapy was applied. Platinum-filtered radium needles com-

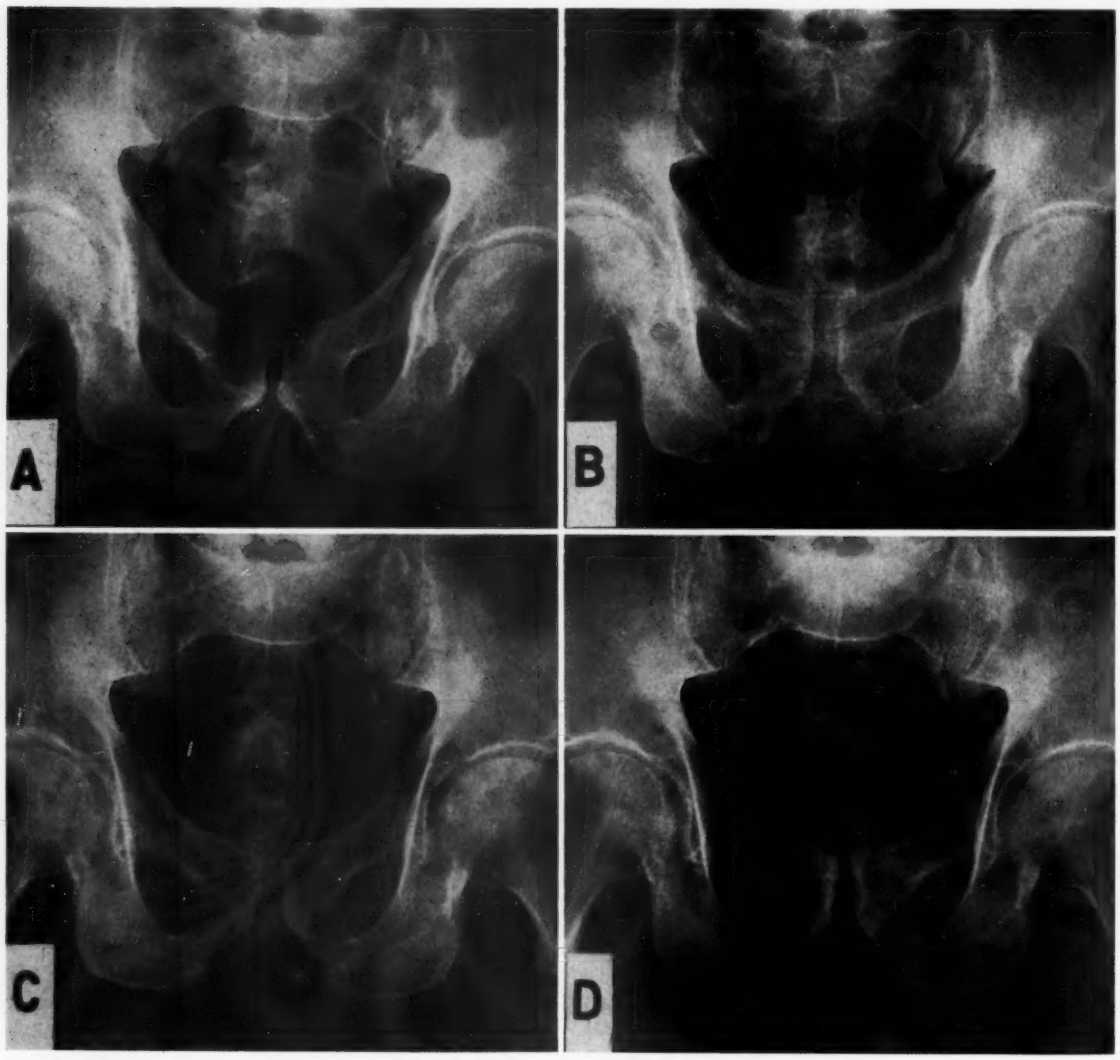

FIG. 3. Case III. Osteitis pubis. (*A*) Before treatment (five weeks after suprapubic prostatectomy), (*B*) six weeks, (*C*) five months and (*D*) eleven months later.

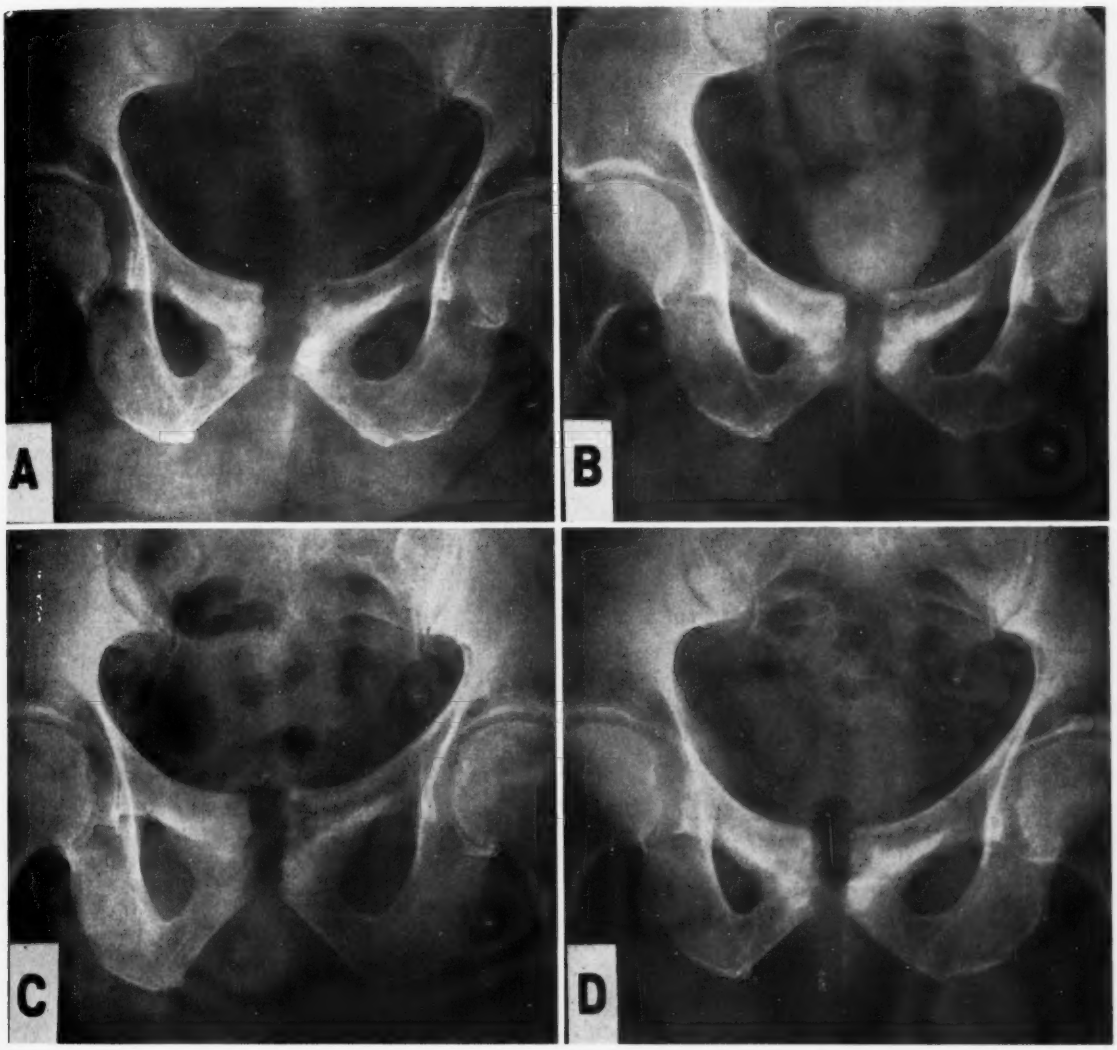

Fig. 4. Case IV. Osteitis pubis erroneously diagnosed as carcinomatous extension from a presumed recurrence six years after a primary lesion of the bladder. (*A*) Before treatment, (*B*) two and one-half months, (*C*) eight months and (*D*) one and one-half years later.

bined with intravesical tubes were used in a suitable distribution and a total dose of 4,000 gamma roentgens was given in a period of forty-eight hours.

March 5, 1943. Discharged.

There was excellent response to the treatment and a complete healing resulted within about three months.

The patient continued to enjoy good health and pursued his normal occupation until January, 1949.

January 7, 1949. Patient developed recurrence of the urinary symptoms with excruciating pain in the region of the symphysis and both crotches.

February 7, 1949. Readmitted to Harper Hospital. Roentgenograms of the pelvis revealed separation of the symphysis with destruction of the adjacent portion of the pubic bodies (Fig. 4, *A*). Additional roentgenograms of the spine and chest remained negative.

February 9, 1949. Cystoscopy showed a marked distortion of the vesical neck and bladder. There were several local areas of inflammation with considerable amount of exudate. At one place the exudate could not be wiped off and it was suspected that a recurrent tumor was present although a clear view could not be obtained on account of the distortion of the structures.

February 12, 1949. Intravenous pyelography demonstrated an irregular, greatly contracted bladder with bilateral hydroureter and hydronephrosis.

A clinical diagnosis of recurrent carcinoma of the bladder with metastasis to the pubic region was made and palliative lead therapy associated with roentgen irradiation was recommended.

February 14, 1949. 120 mg. colloidal lead orthophosphate was injected intravenously.

February 16 to 26, 1949. A full course of supervoltage roentgen therapy was administered, the pubic region being crossfired through one anterior, one posterior and two lateral fields. The factors were: 500 kv. (const.) with 7 mm. Cu, half-value layer of 9 mm. Cu, 3 ma., 20 r per minute, and 60 cm. skin target distance. The total dose on the pubic region amounted to 2,000 r.

February 26, 1949. Discharged.

May 31, 1949. The patient returned in an ambulatory condition. There was a striking improvement in his symptoms. Roentgenograms of the pelvis, however, showed definite advance in the destructive process. The symphysis again was widened, mainly at the expense of the right pubis, although the left was likewise involved. There was loss of normal bone texture at the margins of the symphysis with irregular areas of increased and decreased density. There was a fairly circumscribed area of decreased density in the left inferior pubic ramus and a similar, somewhat larger area in the left ischial tuberosity (Fig. 4, *B*).

June 1 to 10, 1949. A second course of colloidal lead therapy and supervoltage roentgen therapy was given. The technique was identical to that of the first course.

October 10, 1949. The patient was in good general condition. Roentgenograms showed separation of the symphysis with some sclerosis in the adjacent portions of the corpora pubis (Fig. 4, *C*).

September 14, 1950. Checkup roentgenograms demonstrated definite further increase in the sclerosis of the pubic bones and, except for some separation of the symphysis, the pelvis appeared normal (Fig. 4, *D*).

Comment. In retrospect, there can be no doubt that this patient, too, similar to Case 1, had osteitis pubis rather than metastatic carcinoma. The clinical course and especially the roentgenographic features constitute confirmatory evidence.

DOSE

Considering the fact that osteitis pubis is a self-limiting disease it is difficult to evaluate the magnitude of the roentgen dose which would lead to the best therapeutic effect. In most of the cases cited from the literature and in Cases I and IV of the present report rather larger total doses were used, nearly approaching those required for the treatment of metastatic carcinoma. It appears, however, that such large doses are not necessary.

It is recommended that focal doses of 75 to 100 r be given at triweekly intervals with 200 kv., 1 mm. Cu, until the acute symptoms have subsided and at gradually spaced intervals thereafter. A hospitalization may be advisable for the first treatment, whereas the others usually can be administered with the patient ambulant. No orthopedic measures were applied in any of the 4 cases described in the present report; neither were there any auxiliary methods of treatment used, except mild sedation when the pain was very severe.

The roentgen irradiation is discontinued as soon as a satisfactory alleviation of symptoms is obtained. No effort is made to extend it until a full restoration of the bone architecture has also occurred.

SUMMARY AND CONCLUSIONS

(1) Osteitis pubis is a self-limiting disease representing a definite clinical entity.

(2) A review of the literature reveals that in the early days cases of frank osteomyelitis pubis or of suppurative infections spreading to the os pubis were included in the collected series of osteitis pubis.

(3) A re-analysis of the available publications shows that only 33 cases of undoubted osteitis pubis were reported from 1924 to 1946, whereas during the last three years the figure rose to 83, making a total of 116 reported cases. To these are added 4 personal cases. It is probable, however, that the incidence is considerably higher.

(4) Osteitis pubis is engendered by urologic surgery. It occurs as an aftermath of suprapubic and especially retropubic pros-

tatectomy. Rarely, it is also encountered in transurethral prostatectomy and after other operations in which the bladder has been opened suprapubically. It is not presumed to follow uncomplicated perineal prostatectomy.

The cases in which osteitis pubis was reported secondary to non-urologic surgery, such as herniorrhaphy, symphysiotomy, etc., are nearly all cases of frank osteomyelitis or osteitis pubis complicated by osteomyelitis.

(5) Occasional cases of osteitis pubis have also been described following external trauma to the pubic region, pyelonephritis and other non-surgical causes.

(6) Its clinical features are excruciating pain, tetanic contractions of the muscles with pull on the affected portions of the bone and in many instances complete disability lasting for many months.

(7) The roentgenologic features differ according to whether the disease is in the (a) prodromal, (b) destructive or (c) regenerative stage. The appearance is characteristic and constitutes the most important objective sign in establishing a correct diagnosis.

(8) The prognosis of osteitis pubis is invariably good. There is no mortality and the healing is complete. A death rate of from 5 to 8 per cent was reported by several authors but it appears that cases of profuse local suppuration and septicemia were included in the tabulation, whereas in these cases osteitis pubis, if present at all, was incidental. It is more probable that death resulted from the severe infection which had its inception in some other source than the osteitis pubis.

(9) The treatment is symptomatic and supportive. Its aim is to alleviate the usually excruciating pain and to shorten the self-limited clinical course. Roentgen therapy, either alone or in combination with other methods, accomplishes both. The pain is relieved within a few weeks or months and the period of disability is reduced from an average of ten months to an average of six months. A complete reossification of the bone occurs within one to two years.

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DISCUSSION

DR. HUGH F. HARE, Boston, Mass. I hope all of you will have the opportunity to read Dr. Leucutia's article when it is published. He has reviewed all reported cases and has made a very thorough investigation of this disease.

If he is to be criticized at all, it would be in not doing biopsies on what he thought were metastatic lesions. I would be criticized in our own cases, which are not as numerous as his, for not doing the same thing.

The etiology of the disease, as you can tell from Dr. Leucutia's paper, is unknown. It must be of metabolic origin of some type. I am not sure that there is actual bone destruction, because the regeneration and the return of the bony trabeculation to normal is too exact for destruction to have been present. I believe it is merely a washing out of the visible bony trabeculae.

Dr. Leucutia asked me to discuss this paper to see if I could correlate this disease in any way with osteitis condensans ilii. That condition also follows trauma, usually in young mothers, and we have a very similar end result as far as the roentgenogram is concerned, of having dense sclerotic bone around the margins of the sacroiliac joint, with the disease limited to the ilia. I believe this is a similar situation. We cannot prove it, but there is one difference that we have noted—that in 2 cases of osteitis condensans ilii the abnormal bone has completely disappeared. True, this condition may do the same with a longer follow-up. Some of our cases have been under follow-up for ten years.

We made the same mistake that Dr. Leucutia did in making our original diagnosis, and thought we were dealing with a metastatic malignancy. We did not use roentgen treatment which would have helped our patients; but I think the differential diagnosis is so clear cut here that there is no excuse in the future, after having this brought to our attention, for ever making a similar mistake again.

VOL. 66, NO. 3

MALIGNANT TESTICULAR TUMORS

CLINICAL AND THERAPEUTIC EVALUATION OF 158 CASES*

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THE report herein presented is a record of the experience gained in the management of malignant tumors of the testicle at the U. S. Veterans Hospital, Bronx, New York. This institution is one of the larger tumor centers of the Veterans Administration in the East.

PATHOLOGY

The classification of malignant testicular tumors employed in the Department of Pathology is as follows: (1) seminoma, (2) embryonal carcinoma, (3) teratocarcinoma, (4) choriocarcinoma. In many of the cases two of these histopathological entities were found in the same individual. For the purposes of this study they are included only in the category of the more malignant type. A small miscellaneous group (4 cases) will be omitted from the ensuing discussion. All cases were histopathologically proved.

INCIDENCE

In the past fifteen years a total of 1,011,412 patients were admitted to this hospital, among whom were 158 with malignant testicular tumors—an incidence of 0.015 per cent. The incidence is more accurately reflected in the statistics for the period after 1943, when veterans of World War II, a generally younger age group, were seen in significant numbers. The number of admissions during the period 1944–1948 inclusive was 50,650, of which 113 (0.22 per cent) were patients with malignant tumors of the testicle. In the present series, seminoma and embryonal carcinoma showed an equal incidence of 36.4 per cent; teratocarcinoma, 15.2 per cent and choriocarcinoma, 6 per cent (Table 1).

AGE

The average age of the entire series was thirty-five years. The patients with seminoma belonged to the oldest age group (average 37.7 years); the patients with choriocarcinoma, to the youngest age group (average 26.3 years). The average age of the embryonal carcinoma group was thirty-three and that of the teratocarcinoma, 31.3.

TABLE I

INCIDENCE

Type	Number	Per Cent
Seminoma	58	36.4
Embryonal carcinoma	58	36.4
Teratocarcinoma	24	15.2
Choriocarcinoma	10	6.0
Miscellaneous*	4	3.0
Type undetermined†	4	3.0
Total	158	

* Lymphosarcoma 1, reticulum cell sarcoma 2, rhabdomyosarcoma 1.

† These cases, among the first in the series, were given preoperative irradiation to the testicle and no histopathological diagnosis could be made.

RACE

It is of unusual interest that all of our patients were white. Particularly is this so because the Negro population of the hospital is approximately 12 per cent. Other observers[2,3,6,7,8,9,11,13] have noted the extremely low incidence of malignant testicular tumors in Negro patients. The significance of this fact is not apparent.

SYMPTOMS

The most common symptom and sign was testicular swelling. The right testicle

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Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the authors are the result of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

was involved in 96 cases (61 per cent) and the left side in 62 cases (39 per cent). This observation is in agreement with reports of other investigators who noted a similar relative frequency on the two sides. Two cases of bilateral testicular tumors were noted in our series. In only 32 cases (20.3 per cent) was testicular pain a significant symptom. Back pain, which usually indicates retroperitoneal metastases, was one of the presenting symptoms in 12 cases (8 per cent), and abdominal pain in 10 cases (7 per cent).

In several cases, distant metastases, such as supraclavicular adenopathy or abdominal masses, directed attention to the testicle, where a tumor was then found. In 1 case the diagnosis was made only on autopsy, when a minute tumor was found within the substance of the testicle.

A history of trauma was elicited in 26 cases (16 per cent). Hydrocele was present in 8 cases (5 per cent), non-descent of the testicle was noted in 7 cases (4 per cent), and there was a history of orchitis in 3 cases (2 per cent).

The testicle is too frequently neglected in the course of routine physical examinations. A malignant tumor of the testicle should be considered in the differential diagnosis when a patient presents himself with an abdominal mass, supraclavicular

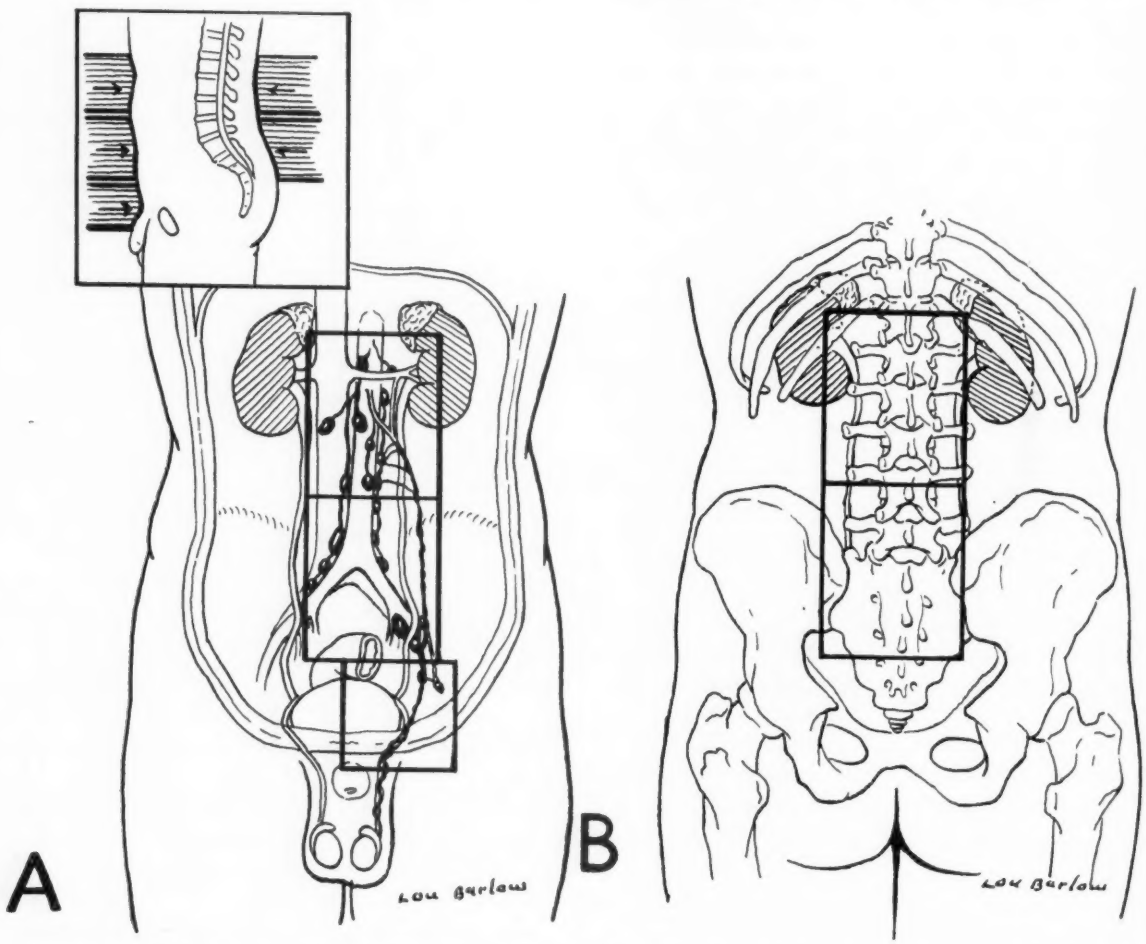

FIG. 1. (*A*) and (*B*). Lymphatic drainage of the testicle (after Rouviere) and arrangement of treatment portals for effective cross-fire irradiation of upper and lower retroperitoneal zones. Note the location of abdominal portals slightly to the left for left-sided involvement.

nodes or other possible foci of metastasis compatible with a primary carcinoma of the testicle.

METASTASES

Metastatic spread of the disease occurs almost invariably by way of the lymphatics. Rouviere[10] has demonstrated that "the lymph trunks of the testicle reach the posterior superior border of the organ, ascend and anastomose along the blood vessels of the spermatic cord. The lymphatics accompany the internal spermatic artery and vein and having arrived at the point at which these blood vessels cross the ureter, the testicular collecting trunks commence to separate from the internal spermatic blood vessels. They then turn medially to the abdomino-aortic nodes by which they are drained. The nodal connections of these lymphatics differ on the right and left sides.

"On the right side the collecting trunks of the testicle run to the abdomino-aortic nodes which line the aorta from the level of the renal vein to the bifurcation of the aorta. On the left side the collecting trunks from the left testicle are likewise drained by the abdomino-aortic nodes. In two-thirds of the cases, all of the left testicular trunks run to the left latero-aortic nodes, subjacent to the renal pedicle and usually terminate in the superior nodes of this group. In a third of the cases some of these reach the pre-aortic nodes.

"The external iliac nodes, placed on the external iliac vein in front of the point where the latter is crossed by the ureter are likewise direct recipients of the lymphatics of the testicle." (Fig. 1A.)

Metastases were demonstrated in 95, or 60 per cent, of our cases, either on admission to the hospital or at some time afterwards in the course of the disease. The incidence was highest in choriocarcinoma and embryonal carcinoma, and lowest in the seminoma group (Table II). The abdominal lymph nodes, peripheral lymph nodes, and chest were the most frequent sites of metastases. Bone metastases were very infrequent, occurring in only 3 cases, all in the seminoma group.

TREATMENT

The plan of treatment of malignant testicular tumors at this hospital conforms with that prevailing at most large clinics in this country. Surgical removal of the involved testicle is followed immediately by radiation therapy to the abdominal lymph node-bearing area.

Table II

INCIDENCE OF METASTASES

	Seminoma	Embryonal Carcinoma	Terato-carcinoma	Chorio-carcinoma	Miscellaneous	Total
With metastases	25 or 43.1%	46 or 79.3%	14 or 59%	8 or 80%	3 or 75%	96 or 61%
Without metastases	33	12	10	2	1	58

In performing orchiectomy the spermatic cord is freed, ligated and cut at the level of the internal ring, following which the testicle and cord are removed *en masse*. Resection of the retroperitoneal nodes is not practiced at this institution because the urologists feel that adequate dissection is not technically feasible. If no involved nodes are present, a dissection is not deemed necessary; if they are present, total removal is considered impossible.

All patients, regardless of the type of tumor, are given postoperative deep roentgen therapy, using, for the most part, 400 kv., Thoraeus filter, half-value layer 4.3 mm. Cu, 5 ma., 70 cm. target-skin distance. A daily depth dose of 150 r is given to the upper and lower abdominal zones alternately, and 100 r daily to the inguinal region. If no metastatic nodes are clinically demonstrable (referred to as "prophylactic" below), three anterior portals are used—(1) epigastric, (2) lower abdominal, and (3) inguinal—and two fields

are used posteriorly—(1) combined upper lumbar and lower dorsal, and (2) lower lumbar (Fig. 1). Thus cross-fire radiation is delivered to the upper and lower retroperitoneal zones and to the inguinal area for a depth dose of 2,000 r for seminoma, and 3,000 r for the other histopathological g oups.

The choice of 2,000 r as the appropriate depth dose in seminoma is based on the

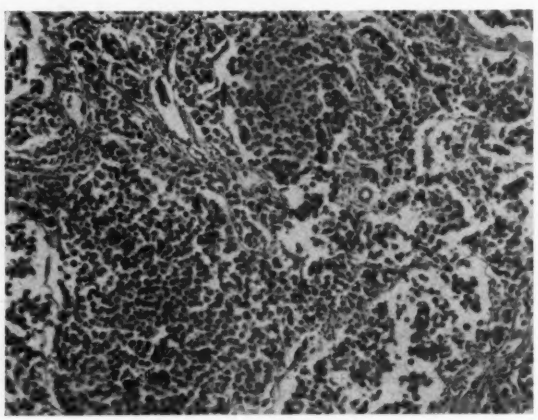

FIG. 2. Case 1. Metastatic seminoma, left supraclavicular lymph node.

observation in this clinic that radiosensitive tumors in this group will respond to this dosage level. On the other hand, radioresistant seminoma, as will be shown in the case reports presented below, did not respond significantly to higher doses.

The depth dose of 3,000 r is arbitrarily selected for the other groups because it may and does cure a small number of relatively radioresponsive tumors. In radioresistant tumors little benefit is to be expected even with considerably higher doses, except at the risk of damage to normal tissues in the path of the beam.

When metastases are clinically evident (referred to as "therapeutic" below), they are treated to the point of clinical regression.

An attempt is made to deliver an adequate dose in one course of treatment, rather than to give small, repeated courses.

Roentgen examination of the chest and excretory urography are carried out routinely to determine the presence or absence of metastases. In addition, upper gastrointestinal series, including studies of the retrogastric and retroduodenal spaces, have been employed, according to a technixue formulated in this clinic by Sheinmel and Mednick.[12] Weekly blood counts are performed to watch the impact on the hemopoietic system. Radiation sickness is controlled by adrenal cortical hormone (desoxycorticosterone acetate),[4] pyridoxine, transfusions, and general supportive measures.

The following 5 cases illustrate the wide variability in the clinical course of seminoma under irradiation.

REPORT OF CASES

CASE 1. A white male, aged twenty-five, was admitted to the hospital on February 27, 1947, with the complaint of swelling in the left supraclavicular region since November, 1946. In February, 1947, a biopsy of the node was reported as "seminoma" at Memorial Hospital, New York (Fig. 2).

On admission to this hospital, a small tumor was noted in the upper pole of the left testis, and a firm nodular mass was found in the left upper abdomen. There were large firm lymph nodes in the left axilla and several matted lymph nodes in the left supraclavicular region. Roentgen studies of the chest showed a widening of the superior mediastinum, but the lungs were clear. Gastrointestinal series, including lateral studies, showed a large retrogastric mass (Fig. 3).

It was decided to irradiate preoperatively to determine the radiosensitivity of the tumor. Accordingly, between March 7 and March 18, 1947, 1,000 r (in air) was given to an 8 cm. square portal over the left testis, using 400 kv., half-value layer 4.3 mm. Cu, 70 cm. target-skin distance, 5 ma., 13 r per minute, at the rate of 100 r (tumor dose) per day. In addition, roentgen therapy was begun with the same technique to a 10 cm.^{2} portal over the left inguinal region, paired 15 cm.^{2} anterior and posterior portals over upper and lower abdomen, two opposing 10 by 20 cm. portals over the mediastinum, and single 10 cm.^{2} fields over the lower neck posteriorly, the left axilla and left supraclavicular region.

On March 21, 1947, the left testicle was re-

moved and the pathological report was "radiation atrophy." On March 24 treatment was resumed to the lymph node-bearing areas, giving 100 r (in air) daily to each of two fields. Treatment to the abdominal and mediastinal areas was abandoned after a depth dose of 500 r to each area because of uncontrollable leukopenia and radiation sickness, but a dose and left axilla through 10 cm.^{2} fields; to paired 10 by 12 cm. upper and lower mediastinal portals; and to opposing 15 cm.^{2} upper and lower abdominal portals, giving 200 r (in air) to each of two fields daily. The factors were the same as in the previous course. Because of unmanageable radiation sickness and leukopenia, roentgen therapy was again interrupted, so

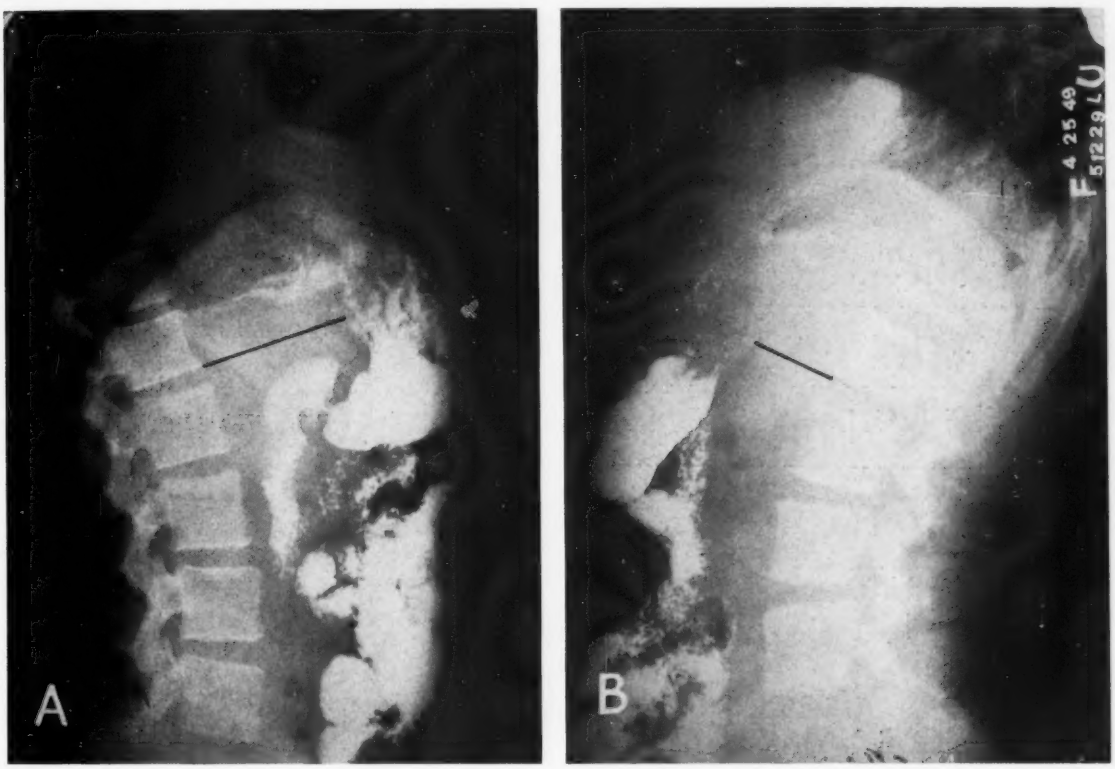

Fig. 3. Case 1. Right lateral recumbent (*A*) and left lateral upright (*B*) studies of the stomach, showing anterior displacement by retrogastric and retroduodenal masses.

of 2,500 r (in air) was given to the left supraclavicular region and 1,500 r (in air) to the left axilla. By May 14, when all therapy was discontinued, the abdominal mass had disappeared (Fig. 4) and there remained only a few small lymph nodes in the left axilla and left supraclavicular region.

On April 13, 1949, the patient returned with the complaint of pain in the left lumbar region. On examination, a large firm mass was felt in the midline of the lower abdomen and there were discrete left supraclavicular nodes. Excretory urogram showed lateral displacement of both ureters and rotation of the kidneys on their vertical axes (Fig. 5*A*). Roentgen therapy was recommenced to the left supraclavicular region that by June 29, 1949, when therapy was discontinued, the abdomen had received depth doses of only 900 r to the lower and 700 r to the upper segments, the mediastinum only 500 r in depth in its upper portion and 400 r in the lower, and the left supraclavicular and axillary regions, depth doses of 2,000 r each. Despite the obvious inadequacy of these doses, the abdominal mass was no longer felt and the ureteral displacement and renal rotation were no longer apparent in the urogram (Fig. 5*B*). A suggested biopsy of a supraclavicular node after a dose of only 600 r (in air) had been delivered was not feasible because lymph nodes were no longer palpable at that time.

At present, because attempts to continue

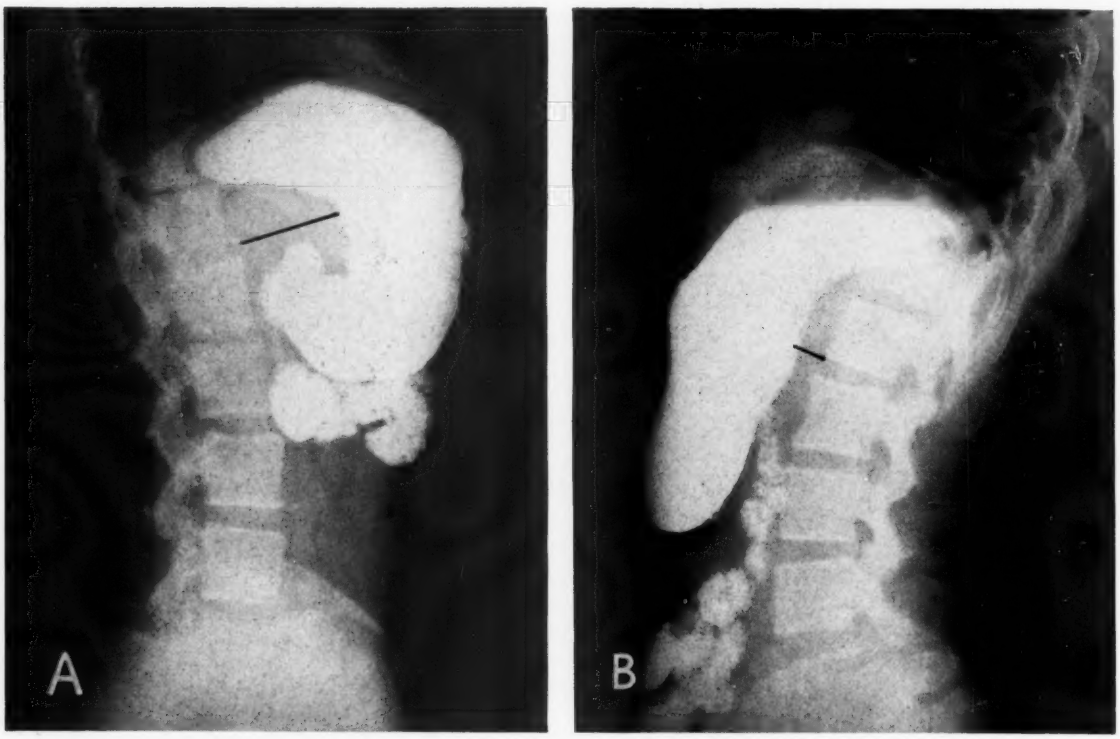

FIG. 4. Case 1. Same views as in Figure 3, following roentgen therapy. Note the decrease in degree of anterior displacement of stomach and duodenum.

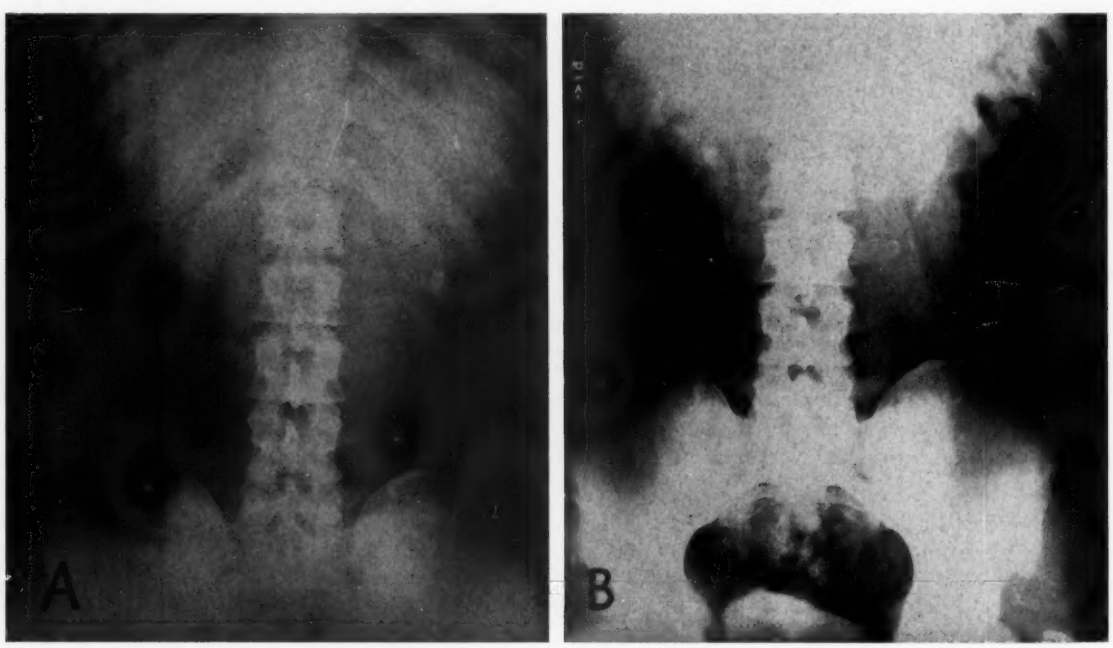

FIG. 5. Case 1. Excretory urograms. (*A*) Before treatment. Note the lateral displacement of both ureters and rotation of the kidneys on their vertical axes. (*B*) After roentgen therapy. Ureteral displacement and renal rotation are less evident.

irradiation to the abdominal portals failed as a result of violent uncontrollable radiation sickness, treatment has been suspended with only a few small shot-like lymph nodes remaining in the left neck and axilla.

Case II. A white male, aged fifty-one, was admitted to the hospital for treatment for duodenal ulcer. In the course of physical examination there was noted a swelling of the right testicle and epididymis, a large mass in the right lower quadrant of the abdomen and the presence of an enlarged, firm node in the left supraclavicular region. Biopsy of this node was reported as "seminoma" (Fig. 6). No chest metastases were noted roentgenographically.

Because the disease was already widespread, it was decided to treat all the involved areas, including the site of the primary tumor, by irradiation. Accordingly, the following fields were mapped out: two anterior and two posterior 10 by 15 cm. portals over the upper abdomen; two anterior and two posterior 10 by 15 cm. portals over the lower abdomen; one 10 by 12 cm. right inguinal portal (over the mass); one 5 cm. circular portal over the right testicle; and anterior and posterior 10 by 15 cm. portals over the mediastinum. The abdominal and testicular portals were treated first using 220 kv., half-value layer 2.2 mm. Cu, 15 ma., 50 cm. target-skin distance, 22 r per minute. Between July 17, 1943, and August 11, 1943, 150 r (in air) was given daily to the testicular field and to two of the four abdominal fields alternately for a total of 1,000 r (in air) to each of the abdominal portals, and 2,400 r (in air) to the testicle. On the basis of depth dose tables, it is estimated that approximately 950 r and 500 r respectively were delivered to the upper and lower retroperitoneal lymph node-bearing areas and about 1,400 r to the right testicle. Following this, roentgen therapy was given to the right inguinal region and mediastinum with the 400 kv. technique already described, and between August 12 and September 5, 1943, a depth dose of 1,400 r was delivered to the mediastinum and 1,300 r to the right inguinal region.

By the time the treatment was completed, all masses had receded so that the testicle was now atrophic and there were only a few small lymph nodes palpable in the right lower quadrant.

The patient has continued well until the present, and in repeated follow-up examinations has presented no evidence of recurrence.

Comment. The above 2 cases illustrate extreme degrees of radiosensitivity. In Case I the nodes which recurred two years later were still radiosensitive. Case II demonstrated the extreme radiosensitivity on the part of both the primary tumor and metastases, all of which were eradicated with irradiation alone. The patient is still living, five years after treatment.

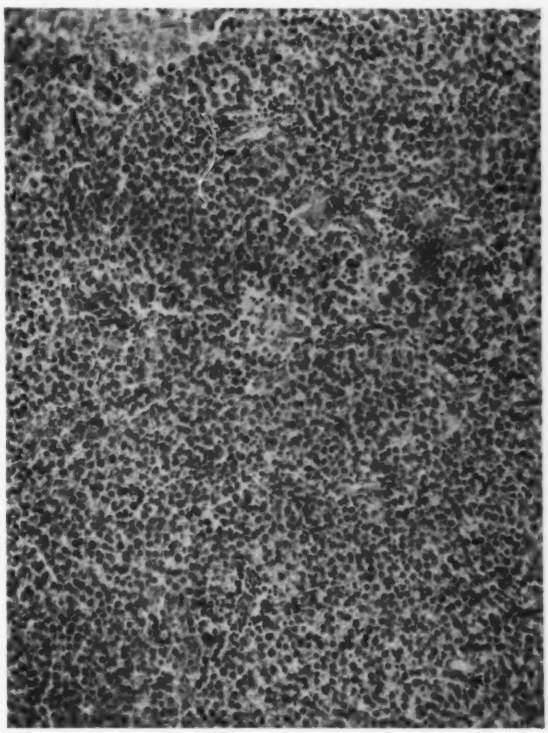

Fig. 6. Case II. Metastatic seminoma, left supraclavicular node.

Case III. A white male, aged thirty, was admitted to the hospital on April 30, 1948, with a history of repeated attacks of cramping umbilical pain of two months' duration, each disappearing spontaneously after about two hours, and severe pain in both testes for the ten days preceding admission. Physical examination showed a 1.5 cm. nodule in the left testis and a 10 by 13 cm. firm non-tender mass in the left upper abdomen. Excretory urography showed only failure of excretion on the left, but retrograde studies showed compression of the left ureter by a soft tissue mass as well as lateral deviation of the upper portions of both ureters, and displacement of the left kidney anteriorly and laterally with dilatation of the

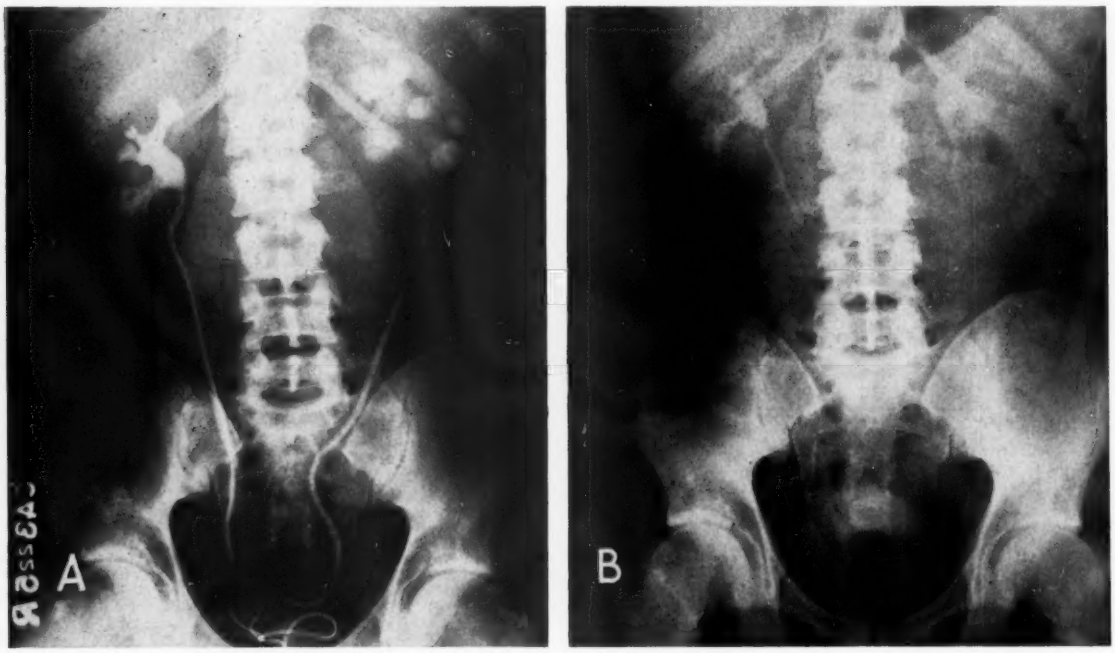

FIG. 7. Case III. (*A*) Retrograde pyelogram before treatment, showing lateral deviation of the upper portions of both ureters, with dilatation of the collecting system on the left. (*B*) Excretory urogram after treatment, showing decrease in the dilatation of the left renal collecting system, as well as in the displacement of the ureters.

collecting system (Fig. 7*A*). Chest roentgen findings were normal. Gastrointestinal series with lateral studies showed retrogastric and retroduodenal masses (Fig. 8).

On June 1, 1948, left orchiectomy was done, and the pathological report was "seminoma" (Fig. 9). On June 8, 1948, roentgen therapy was begun to paired anterior and posterior 17 cm.^{2} upper and lower abdominal portals, using the following factors: 400 kv., Thoraeus filter, 70 cm. target-skin distance, 5 ma., half-value layer 4.3 mm. Cu, and with a daily dose of 150 r

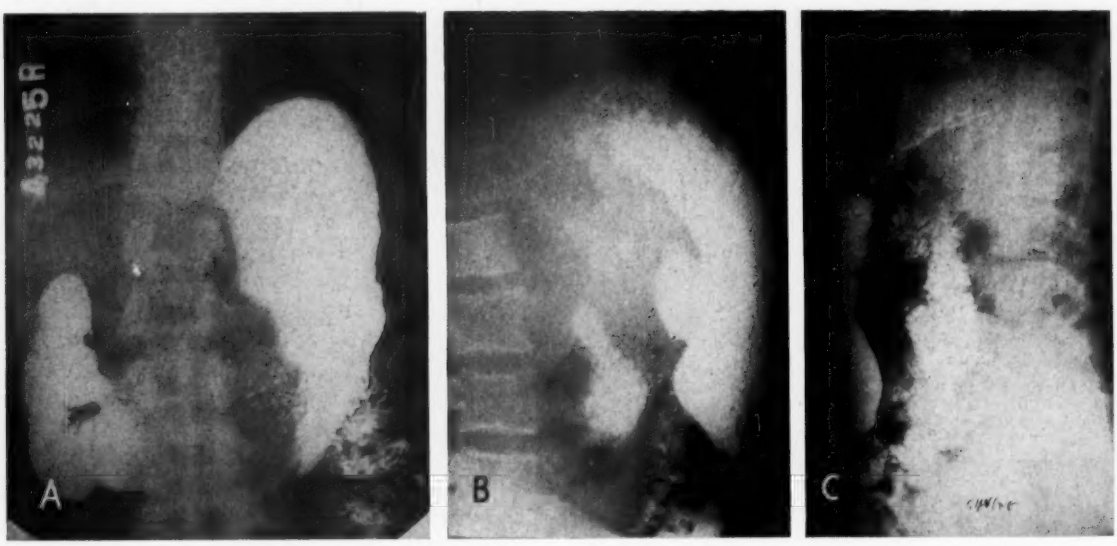

FIG. 8. Case III. Study of the barium-filled stomach in (*A*) posteroanterior, (*B*) right lateral recumbent and (*C*) left lateral upright views, showing the presence of retrogastric and retroduodenal masses.

(in air) to each of two portals. Twenty-five days later 2,000 r had been delivered to the depth in both the upper and lower abdomen, but because the mass was apparently unaffected, treatment was continued to the upper abdomen through the original portals plus an additional lateral 15 cm.^{2} portal, until on August 4, 1948, a depth dose of approximately 5,000 r had been delivered to the mass.

Excretory urogram at this time showed decrease in the dilatation of the left renal collecting system (Fig. 7*B*), as well as in the deviation of the ureters, and return of function of the left kidney. The chest was normal roentgenographically and the patient was asymptomatic. He was discharged to follow-up, and one month later the mass was no longer felt. The left urinary collecting system also showed further improvement.

In December, 1948, on a follow-up visit, a 2 cm. firm, fixed, tender mass was palpated at the anterior end of the right third rib, and a month later a small right pleural effusion was noted on roentgen examination, although previous films had been negative. A dose of 900 r to the depth, which was estimated at 3 cm., caused the mass to disappear, but on February 15, 1949, the patient returned with pain in the right lower chest and bloody fluid in the right pleural cavity. A dose of 1,350 r (in air) was given to a 10 cm. circular portal over the right lower chest, using 250 kv., 15 ma., Thoraeus filter, half-value layer, 3.2 mm. Cu, 50 cm. target-skin distance. Following this course, there was some relief from pain, but on its completion, a destructive lesion was noted in the right seventh posterior rib (Fig. 10*A*). On March 4, 1949, treatment was begun to an 8 by 15 cm. portal over the involved rib and in

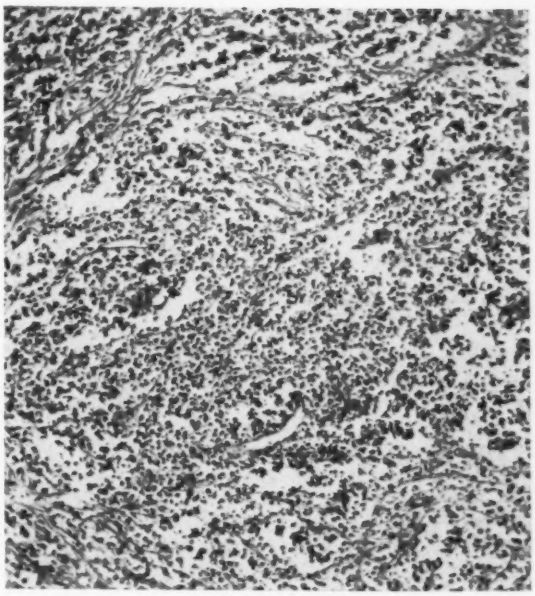

Fig. 9. Case III. Seminoma, left testicle.

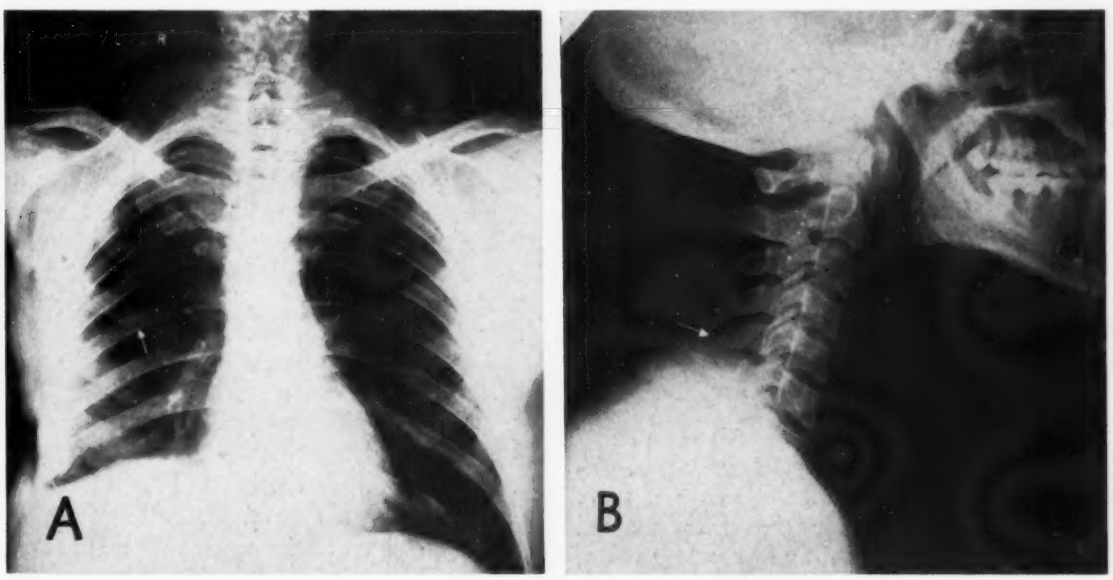

Fig. 10. Case III. (*A*) Destructive lesion of the posterior segment of the right seventh rib (arrow). (*B*) Destructive lesion involving the spinous process of the sixth cervical vertebra (arrow).

three weeks 2,600 r (in air) was given, using 200 kv., 1 mm. Cu and 1 mm. Al filter, 15 ma., 50 cm. target-skin distance, with good relief from pain. At this time fullness of the right breast was noted. Roentgen studies of the chest showed no change in the bone lesion, but the right diaphragm was elevated and there was persistent right pleural effusion. Shortly after completion of treatment the patient began to complain of radicular pain down the right leg, as well as paresthesia down the ulnar aspect of the left arm. Films of the cervical spine (Fig. 10*B*) showed destruction in the spinous process of the sixth cervical vertebra, but the dorsal and lumbar spine were normal. It was the opinion of the neurological consultant that there were cerebral metastases as well as involvement of the roots of L-2 to L-5.

The patient died on May 15, 1949. Permission for autopsy was not granted.

CASE IV. A white male, aged forty-two, was admitted to the hospital in September, 1948, with a history of swelling of the left testicle and pain in the back, both of four years' duration, and both said to have begun following a fall. Orchiectomy was done on October 1, 1948, and the patient was referred for radiation therapy on October 13, 1948. The surgeon noted that the tumor extended along the entire visualized portion of the spermatic cord and could not be removed completely. Pathological diagnosis was "seminoma" (Fig. 11*A*).

When seen in the radiotherapy clinic the patient had large, firm, slightly tender masses in the left upper quadrant. Excretory urography showed a mild left hydronephrosis with lateral displacement of the left ureter, presumably due to pressure by lymph node masses (Fig. 12).

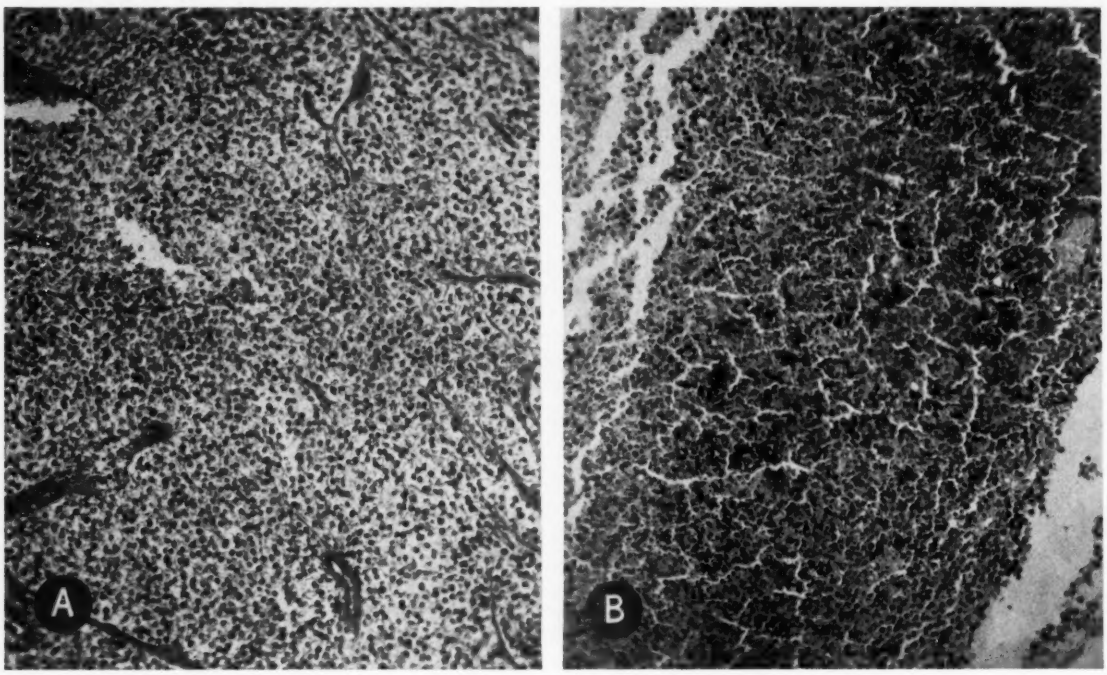

FIG. 11. Case IV. (*A*) Seminoma, left testicle. (*B*) "Metastatic carcinoma, consistent with seminoma." Material from aspiration biopsy of left supraclavicular lymph node.

Treatment was begun on October 13, 1948, to paired 15 cm.^{2} portals over the upper and lower abdomen, and single 12 cm.^{2} and 8 cm.^{2} portals over the left inguinal and left supraclavicular regions respectively, using the 400 kv. factors already outlined and giving 150 r (in air) daily to each of three portals. (The supraclavicular field was treated because of a roentgen-ray density, suspected of being a metastatic focus, in the left pulmonary apex.) Between October 13 and December 8, 1948, 2,400 r was given to the upper abdomen, 2,650 r to the lower abdomen, 1,650 r to the left inguinal region and 1,800 r to the left supraclavicular area (all doses at the depth).

Treatment had to be discontinued because of leukopenia, and at this time it was noted that there was a nodule about 2 cm. in diameter in the left inguinal region within the treated field, but that the left upper quadrant masses were no longer palpable.

Roentgen therapy was resumed on December 28, 1948, to a 10 cm.^{2} left inguinal portal and to two cross-fired 12 by 17 cm. portals over the mediastinum. A daily dose of 150 r (in air) to each mediastinal field and 100 r (in air) to the left inguinal region was given. By January 14, 1948, a depth dose of 1,500 r had been given to the mediastinum and 2,500 r to the left inguinal region. The left inguinal mass was now no longer noted, although the area continued to show induration despite a total dose of about 4,000 r to this region. Treatment was discontinued.

On April 29, 1949, the patient returned for follow-up with the complaint of pain in the left side of the abdomen and back and in the right lower quadrant. At this time no masses were palpable but there was displacement of both ureters laterally in the excretory urogram, presumably by lymph nodes.

In May an enlarged lymph node appeared in the left supraclavicular region. Aspiration biopsy was reported as "metastatic carcinoma, consistent with seminoma" (Fig. 11 *B*).

On July 22, 1949, the patient reported with a large firm mass in the right inguinal region which responded to a depth dose of 740 r. In October, 1949, the patient complained of urinary difficulty and difficulty in walking. Neurological examination pointed to a metastatic lesion involving the roots of L-2 and L-5 on the right. After a depth dose of approximately 400 r was delivered to this area, the patient responded with gratifying palliation. Thereafter, however, the patient's course was rapidly retrogressive and he died on November 9, 1949. Autopsy was reported as seminoma with widespread metastases.

Comment. Cases III and IV illustrate extreme radioresistance on the part of histopathologically proved cases of seminoma with recurrence of tumor in the sites adequately irradiated.

Case V. A white male, aged forty-one, was admitted to the hospital in November, 1947, because of swelling of the left testicle of two months' duration and periumbilical pain, radiating to both loins, for the week prior to admission. Orchiectomy was done on November 19, 1947, and on November 24 the patient was referred for radiation therapy. Microscopic diagnosis was "seminoma" (Fig. 13*A*). On examination in the radiotherapy clinic, a large mass was found occupying the left upper abdomen, and there was a tender lymph node in the left axilla. Excretory urography showed poor excretory function on the left with dilatation of the left renal collecting system (Fig. 14*A*).

Fig. 12. Case IV. Excretory urogram showing mild left hydronephrosis with lateral displacement of left ureter, presumably by lymph nodes.

Treatment was begun on November 24 through two pairs of cross-fired upper and lower abdominal portals, 15 cm.^{2} each, using 400 kv., half-value layer 4.3 mm. Cu, 5 ma., 13 r per minute, 70 cm. target-skin distance. Two fields were treated daily with 150 r (in air) and in thirty-seven days a depth dose of 3,000 r was delivered to the lymph node-bearing areas in both the upper and lower abdomen. It was noted that the left upper quadrant mass had decreased slightly in size and excretory urography on December 27 showed a partial return of the left renal collecting system to normal (Fig. 14*B*).

In August, 1948, the patient returned, complaining of right upper quadrant pain radiating

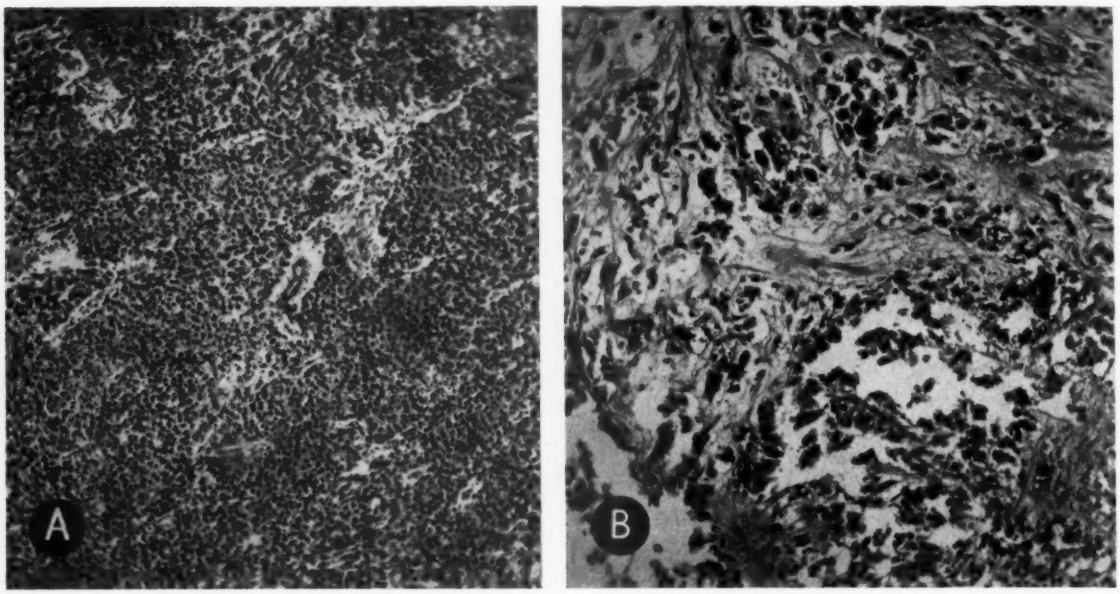

FIG. 13. Case v. (*A*) Seminoma, left testicle. (*B*) Embryonal carcinoma, lymph node removed at autopsy.

to the right side of the neck. The liver was markedly enlarged and a firm mass was again noted in the left upper quadrant. Chest roentgenogram was normal, but excretory urogram showed lateral displacement of the left ureter, and films of the upper gastrointestinal tract showed the presence of a retrogastric mass. Roentgen therapy was reinstituted through two 15 by 17 cm. cross-fired portals corresponding roughly to the original upper abdominal areas,

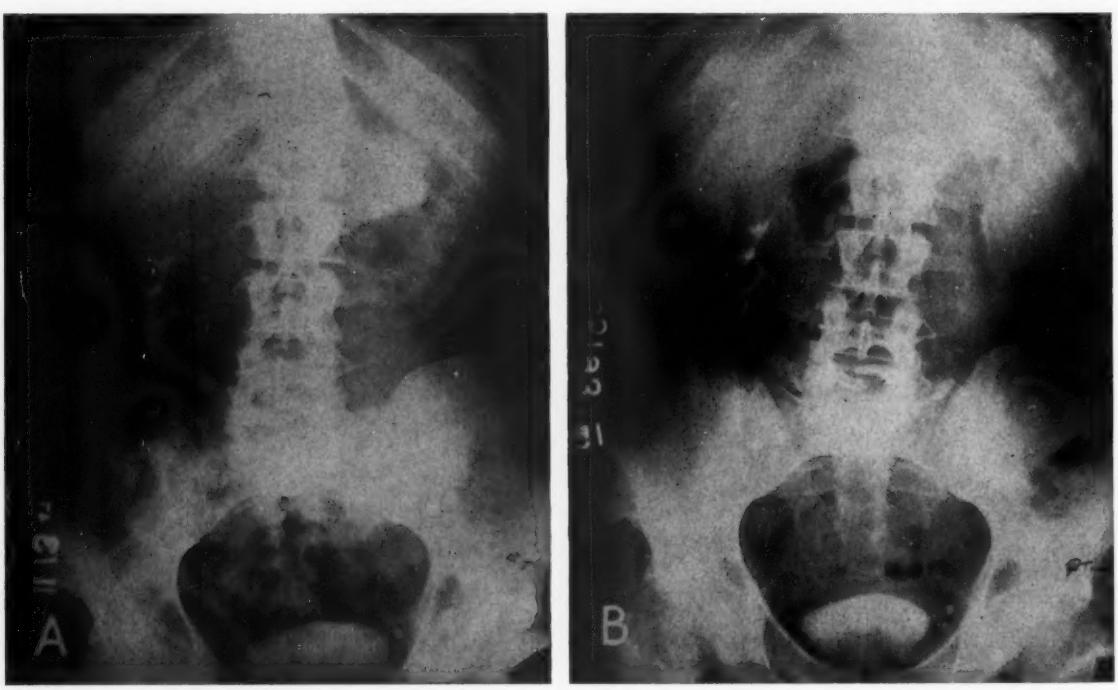

FIG. 14. Case v. Excretory urograms. (*A*) Before treatment, showing poor excretory function and dilatation of the renal collecting system on the left. (*B*) After treatment, showing improvement in the status of the collecting system.

and with the factors used previously. From August 27 to September 14, 1948, a depth dose of 1,800 r was delivered to the upper abdomen with some relief from pain, but no effect on the mass.

Following the discontinuance of therapy, the patient experienced increasing dyspnea and marked weakness, and died on October 3, 1948.

Autopsy showed metastases to the liver, para-aortic lymph nodes and lungs. Microscopic diagnosis was "embryonal carcinoma" (Fig. 13*B*).

Comment. Case v illustrates radioresistance of metastases from a primary tumor which was diagnosed as seminoma. Postmortem revealed embryonal carcinoma. It is possible that a nidus of embryonal carcinoma existed in an unexamined portion of the testicular tumor or that a transformation occurred.*

DISCUSSION

It is the generally accepted practice in the major clinics throughout the country to treat all malignant testicular tumors by orchiectomy and postoperative roentgen therapy. In cases of seminoma the technique has been to irradiate the abdominal lymph node-bearing areas prophylactically after operation. In reality, however, the assumption that the treatment in any particular case is prophylactic is unfounded. Cahill,[1] in a series of 14 cases, found microscopic evidence of metastases on operation in 5 instances where none was found clinically. Friedman,[5] similarly found microscopic metastases in about 40 per cent of the cases operated on at Walter Reed Hospital. In the present series of 18 patients who died within a three year period, 9 had no clinical evidence of metastases when first seen. The concept of prophylactic treatment should probably be discarded and all patients be treated as though microscopic metastases were present.

* Recently a similar case was observed in which the malignant testicular tumor measuring approximately 1 cm. in diameter was discovered only on postmortem examination. The microscopic diagnosis was seminoma, while that of the metastatic spread was embryonal carcinoma.

TABLE III

RESULTS IN SEMINOMA*†

	Prophylactic	Therapeutic	Total
A. Alive but followed less than 3 years	17	4	21
B. Alive 3–5 years	6	0	6
C. Alive 5 years or more	7	2	9
D. Died (before 3 years)	9	9	18
Total			54

* Excluded from this table were: no follow-up 2, no roentgen therapy 1, died of intercurrent disease 1.

† The three year survival rate was 45.5 per cent. It appears that if the patient survives three years, he is not likely to die of the malignant disease.

It must be conceded, however, that in our experience the presence or absence of *clinically demonstrable metastases* has a significant bearing on the prognosis. Thirteen of 22 seminoma cases without clinical evidence of metastases at the onset of treatment lived for a period of three years or more (Table III).

All of the patients with seminoma who are living three to five years after treatment received a depth dose to the para-aortic nodes of 2,000 r or less, in some instances considerably less, because many of these patients were treated elsewhere and sent to this hospital for follow-up. It is felt that a depth dose of 2,000 r is a desirable one and well within the limits of safety to the skin and other normal tissues and organs in the path of the beam. In this series the three year survival was not increased by doses in excess of 2,000 r (Table IV).

A histopathological report of seminoma does not necessarily indicate a favorable prognosis in any individual case because the response to therapy is not predictable on the basis of histopathology alone. This may be due, in our opinion, to one or more of three factors:

1. Inherent differences between cases of seminoma in their response to irradiation (Cases 1 to IV).

2. The possibility of the presence of a nidus of a more malignant tumor which may have been overlooked because of

TABLE IV

CORRELATION OF TUMOR DOSE AND SURVIVAL IN SEMINOMA

Tumor Dose (r)	Died in Less Than 3 Years			Living 3 Years			Living 4 Years			Living 5 Years		
	Total	P	T	Total	P	T	Total	P	T	Total	P	T
500	1	1	—	1	1	—	—	—	—	—	—	—
500–1000	—	—	—	1	1	—	—	—	—	2	1	1
1001–1500	4	2	2	1	1	—	2	2	—	2	2	—
1501–2000	4	4	—	—	—	—	1	1	—	4	3	1
2001–2500	1	—	1	—	—	—	—	—	—	—	—	—
2501–3000	5	—	5	—	—	—	—	—	—	—	—	—
Factors unknown	3	2	1	—	—	—	—	—	—	1	1	—
Totals	18	9	9	3	3	—	3	3	—	9	7	2

P = Prophylactic
T = Therapeutic

The three year survival is not increased by doses in excess of 2,000 r.

failure to examine serially the entire operative specimen (Case v).

3. The possibility of transformation of a seminoma into a more malignant type of tumor (Case v).

The percentage of three year survivals in histopathological types other than seminoma is greatest in the embryonal carcinomas (32.6 per cent), less in the teratocarcinomas (26.6 per cent) and least in the choriocarcinomas (11.1 per cent). Here again, the presence or absence of metastases at onset of treatment is of great significance. Eighteen of the 20 cases who survived three to five years in the above groups had no metastases at onset of treatment. On the other hand, 41 out of 50 who died within a three year period had obvious metastases at the beginning of treatment (Table v).

While the above-mentioned groups, other than seminoma, are radioresistant, all patients should receive irradiation, not only for its palliative benefit but, in some instances, with the objective of a cure, since among our three to five year survivals are 2 such cases.

It is also worth noting that all of the deaths occurred within the first three years following treatment. Hence, the chance of

TABLE V

RESULTS IN OTHER TYPES

	Total	Lost from Follow-up	Cases for Analysis	Died Less than 3 Years			Living but Followed Less than 3 Years			Living 5 Years Plus			Living 3 to 5 Years			Per Cent 3 Year Survival
				Total	P	T	Total	P	T	Total	P	T	Total	P	T	
Embryonal carcinoma	58	3	55	31	6	25	9	5	4	9	8	1	6	5	1	32.6
Terato-carcinoma	24	0	24	11	3	8	9	8	1	3	3	0	1	1	0	26.6
Chorio-carcinoma	10	0	10	8	0	8	1	1	0	0	0	0	1	1	0	11.1

It appears that if a patient survives three years he is not likely to die of the malignant disease.

continued survival is excellent after the three year period.

SUMMARY AND CONCLUSION

During a period of fifteen years (1933 to 1948 inclusive) a series of 158 cases of malignant testicular tumor was treated and observed in the Radiation Therapy Department at the Veterans Hospital, Bronx, New York. Fifty-eight were seminoma, 58 embryonal carcinoma, 24 teratocarcinoma and 10 choriocarcinoma. The remainder consisted of a miscellaneous group which included 2 cases of reticulum cell sarcoma, one of lymphosarcoma and one of rhabdomyosarcoma. In 4 cases the diagnosis was undetermined because preoperative irradiation obscured the histopathological picture. None was observed in the Negro race although 12 per cent of Negroes are found in the hospital population.

All but one of these patients were treated by surgical removal of the diseased testicle, followed by deep roentgen therapy to the lymph node drainage areas in the abdomen. Radiation therapy was given whether or not there existed clinical evidence of metastases to the abdominal lymph nodes.

It has been the practice here to deliver to seminoma cases a tumor dose of about 2,000 r to the lymph node drainage areas in the abdomen. The case studies presented have illustrated the wide variations in the irradiation response of seminoma, ranging from complete regression following small doses, to persistence and recurrence of the malignant disease in spite of intensive radiation therapy. It has been indicated that there are radioresistant seminomas which may not respond to tumor doses appreciably higher than 2,000 r. In other histopathological types the tumor dose was approximately 3,000 r.

The highest percentage of three year survivals was achieved in the seminoma group, 45.5 per cent. Among the embryonal carcinomas there was a three year survival rate of 32.6 per cent, while the teratocarcinomas showed a rate of 26.6 per cent and choriocarcinomas, 11.1 per cent. The three year survival rate for all cases was 34 per cent.

In each histopathological group the presence or absence of clinical metastases was important in the prognosis. In seminoma it was noted that of 22 patients who had no clinical evidence of metastases, 13 survived the three year period. Of 27 patients in the other groups who had no clinical metastases when first seen, 18 survived the three year period.

Of considerable interest is the observation that if these patients survive the three year post-treatment period, the prognosis is excellent.

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REACTION OF TISSUES OF AMPHIBIANS AFTER LOCAL ROENTGEN IRRADIATION*

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AMPHIBIANS are particularly useful as experimental animals in investigations of the biological effects of roentgen rays. In the first place, it is possible to study the effects of irradiation on very early stages of development. It is also significant that adult animals (tritons, axolotls and other salamanders) have the ability to regenerate their limbs, tails and even parts of the head. Thus, in both young and adult animals, it is possible to investigate the effect of roentgen rays upon active growth and morphogenetic processes.

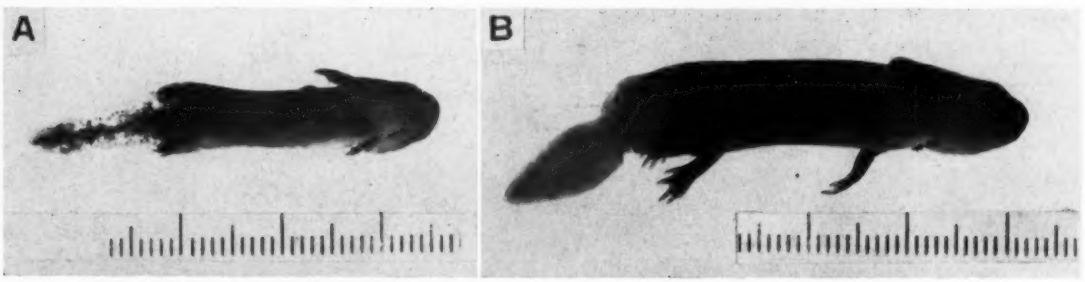

FIG. 1. Photographs showing changes in the appearance of the treated region of axolotls. (*A*) Forty-five days following irradiation. (*B*) Eighty-one days following irradiation.

In a previous paper (Brunst[8,9]) it was shown that in locally irradiated tail or lumbosacral region of axolotls (*Siredon mexicanum*) the first sign of the irradiation effect became evident about twenty days after treatment. In living animals, the treated region was easily distinguished from the neighboring untreated portions because of its typical pale pigmentation (Fig. 1*A*). This change in the pigmentation shows the beginning of the primary acute reaction of the treated tissues to roentgen irradiation. Figure 2 shows a general scheme of primary acute reaction of a locally irradiated tail of an axolotl. The proximal, untreated, region has a normal structure (zone *A-A*). It is possible to distinguish the boundary zones (zones *B-B* and B_1-B_1) and the central irradiated region (zone *C-C* and C_1). The boundary zone *B-B* is typical in that the number of small cells (connective tissue cells and blood cells—lymphocytes and others) are more abundant than normally. The number of the small cells increases gradually towards the distal end. The zone B_1-B_1 has a very large concentration of these cells and a large number of mitotic figures are seen in all of the tissues ("zone of stimulation"). In many cases, the formation of new cartilaginous elements and expanded neural tubes are observed in this zone. In the central irradiated region ("zone of inhibition") it is customary to find suppression of mitotic activity, reduction of pigment layer, a decreased number of connective tissue cells, the presence of active giant cells (macrophages or polyblasts—G.C.) and in most cases, a degeneration of the epithelium (G.E.). The concentration of small cells in the boundary zone and the presence of giant cells (macrophages) in the zone of inhibition was regarded as a sign of an inflammatory proc-

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ess. The inflammation in general is very characteristic of the primary acute reaction to irradiation. Cramer[14] has observed the same picture in the irradiated mice. According to this author, "The effect produced by irradiation in normal skin may, in fact, be described as an aseptic inflammation, to which is superadded the direct injury produced by radium on the epithelial cells. A point to be noted is that a macrophage reaction is found even in the absence of a tumor as a response to the injury on the normal cellular elements of the skin" (p. 104). (See also: Ewing,[18] Koller,[25] Pfuhl and Kühtz,[35] and others.)

It is very important to know how consistently all the signs of the primary acute reaction may be observed. Thus, it is necessary to repeat these experiments using the same conditions of irradiation in various parts of the body and various animals.

A new investigation of roentgen irradiation effects upon the tail development of young axolotls (*Siredon mexicanum*) was initiated. The conditions of irradiation were as follows: 55 kv. max., 3 ma., no filter. The target-object distance was 10 cm. In each experiment the tails of 30 young animals (ten days after hatching) were locally irradiated with 150, 300, 600 and 1,200 r.

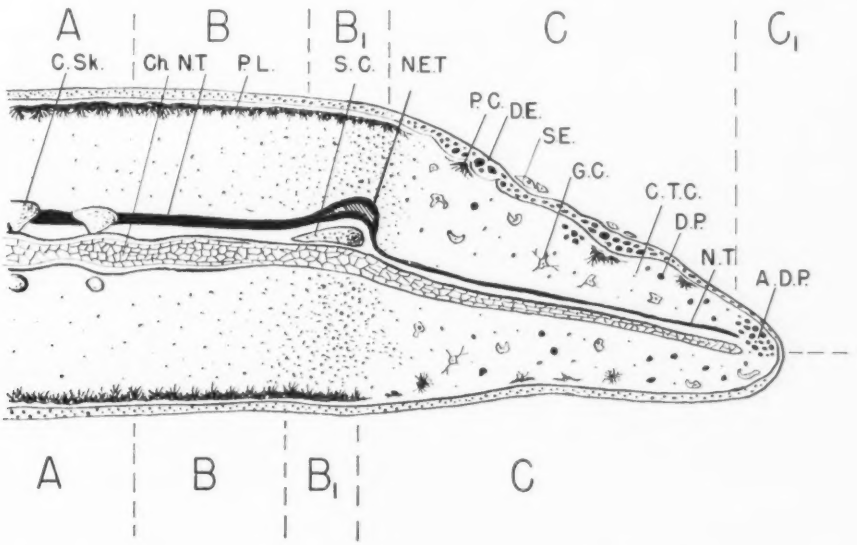
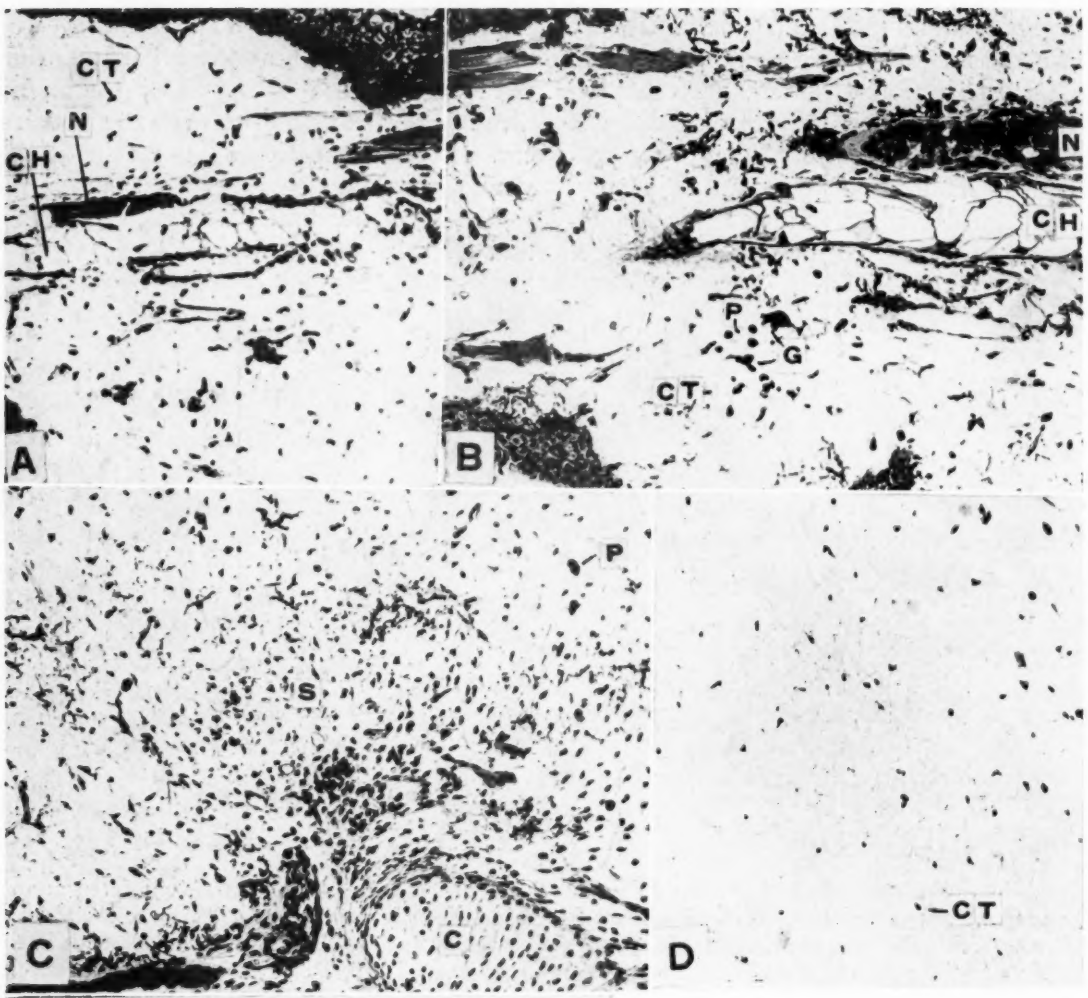


Fig. 2. General schema of the reaction of the axolotl tail to irradiation. Zones: *A-A*, untreated normal tissues; *B-B*, boundary zone; B_1-B_1, boundary zone—"zone of stimulation"; *C-C*, "zone of inhibition"; C_1, zone of accumulation of degenerated pigment cells. C.SK., normal cartilaginous skeletal elements in the proximal region; CH., notochord; N.T., neural tube; P.L., pigment layer; S.C., stimulated cartilaginous element; N.E.T., expanded neural tube; P.C., normal pigment cell; D.E., degenerating giant epithelial cells; S.E., separated giant epithelial cells; G.C., giant cells (macrophages); C.T.C., connective tissue cells (small cell elements in general); A.D.P., accumulation of degenerated pigment cells.

The dose of 150 r is not sufficient to give a visible effect. Doses of 300–1,200 r give the usual picture of primary acute reaction. However, the suppression of growth is especially clear after irradiation with 1,200 r. Figure 3 shows, at low magnification, the zonal peculiarities of the treated tissues of 1 animal fifty-two days after local irradiation with 1,200 r (Fig. 3, *1*). In the central irradiated zone ("zone of inhibition") there can be seen a small quantity of connective tissue cells, some giant cells (macrophages or polyblasts) and degenerating pigment cells (Fig. 3*B*). In the boundary zone (Fig. 3*C*) there is a large concentration of small cells, which are very



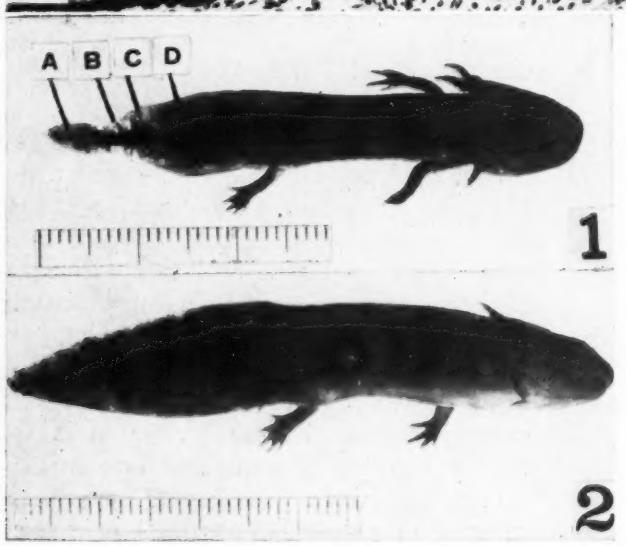


FIG. 3. Comparison of treated and control axolotls, showing the zonal peculiarity of the locally treated tail. (1) Axolotl fifty-two days after irradiation with 1,200 r (62 days after hatching). Photomicrographs (*A*)–(*D*) made from various regions of a longitudinal (medial) section of the tail at the positions indicated in photograph 1 (A, B, C, D). (*A*) The most distal region; (*B*) more proximal—central region of irradiated field; (*C*) more proximal—boundary region ("zone of stimulation"); (*D*) the most proximal—normal (untreated) region.

C, cartilaginous skeletal element. CH, notochord; CT, connective tissue cell; S, small cells in the "zone of stimulation" (connective tissue cells and blood cells). Photomicrograph ×70. (2) Control animal of the same age (62 days) as the animal in photograph 1.

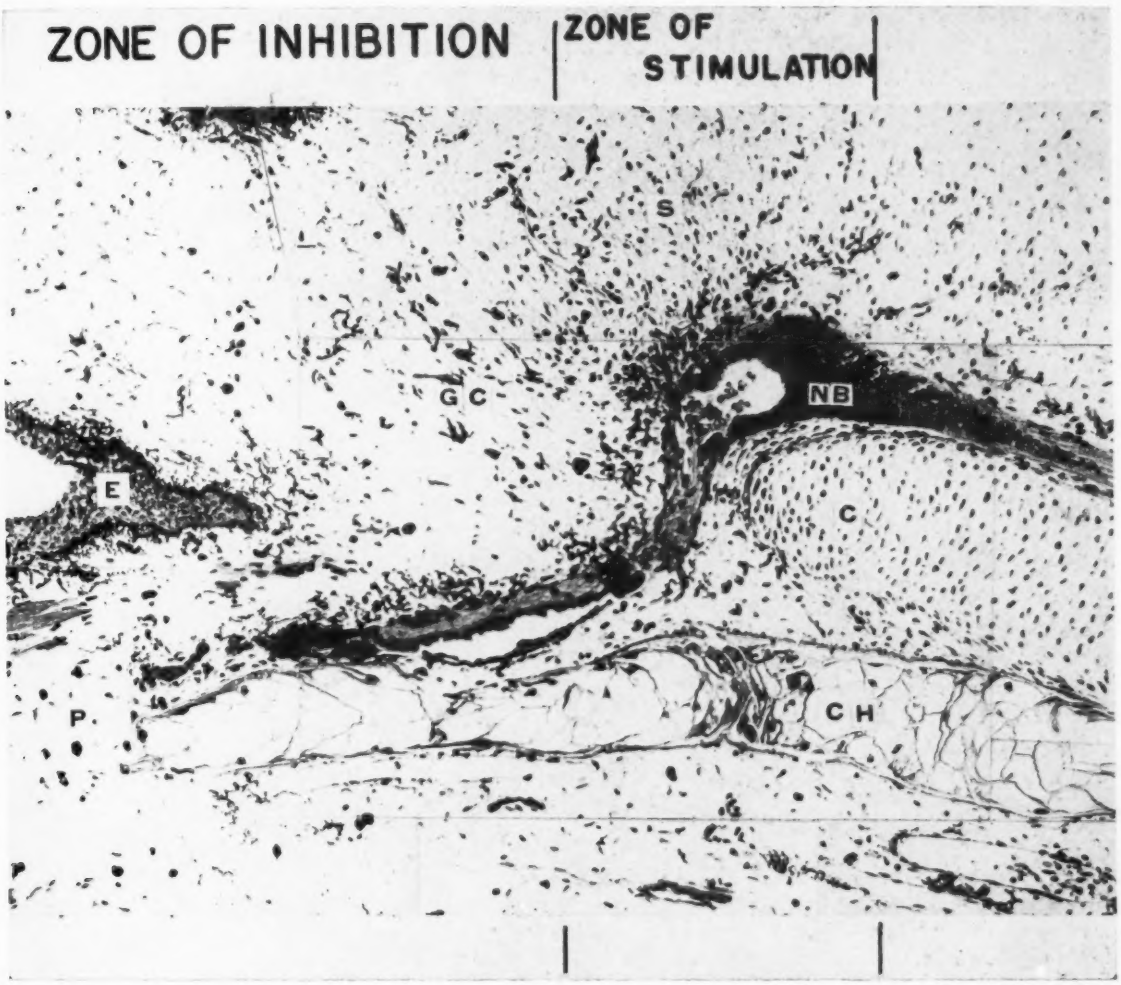
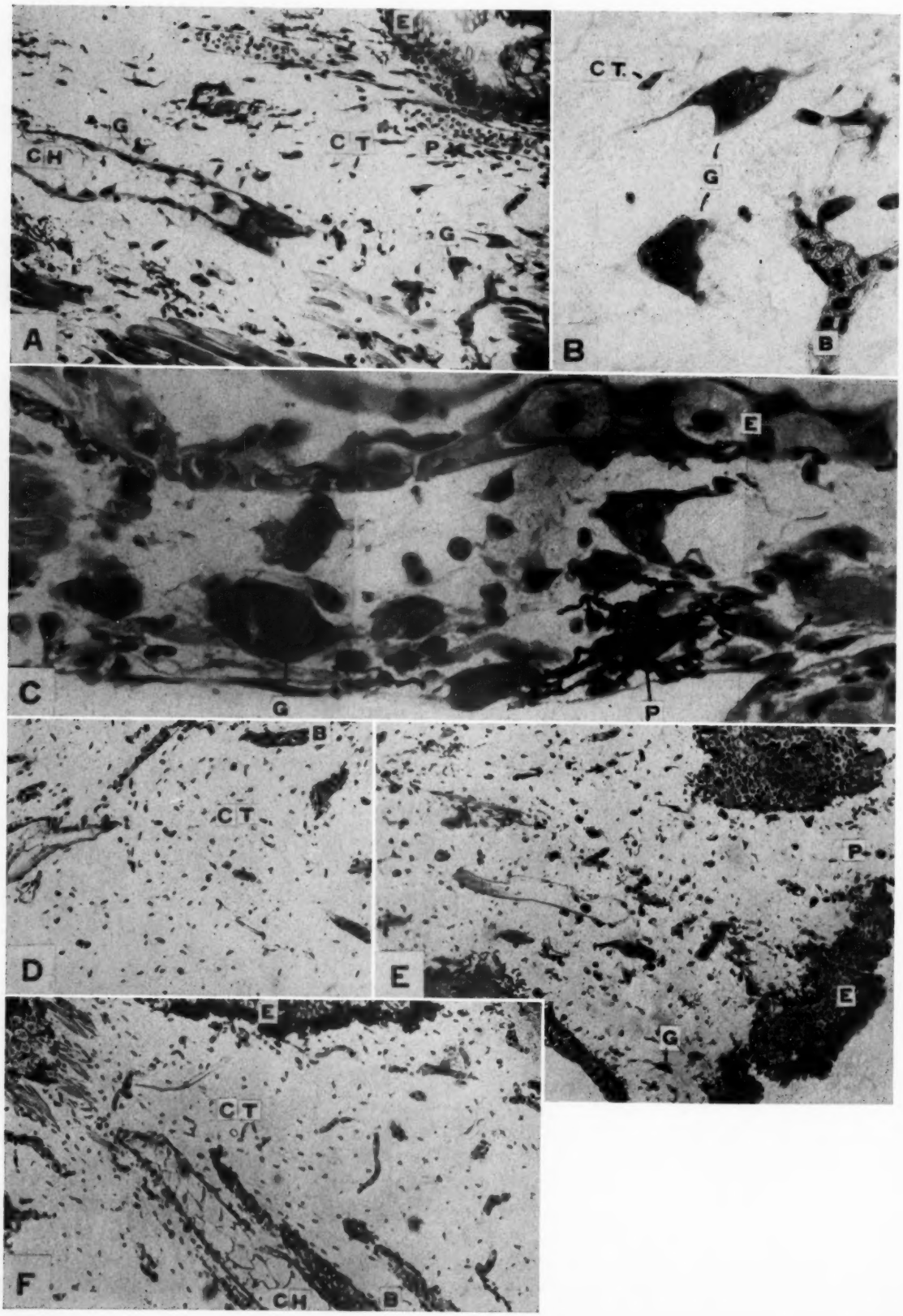


Fig. 4. General picture of the treated region and boundary zone of an axolotl fifty-two days after treatment. C, cartilaginous skeletal element; CH, notochord; GC, giant cells (macrophages); E, epithelium; NB, expanded neural tube (neural bulb); S, small cells in the "zone of stimulation." Photomicrograph ×70.

scarce in the untreated connective tissue in the proximal region of the same animal (Fig. 3*D*). The tissues of the tip of the tail have a more normal appearance. Obviously they were not irradiated with the entire dose (Fig. 3*A*). The appearance of this animal (Fig. 3, *1*) shows that the central irradiation field is in zone B. In comparison with the tail of the control animal of the same age (Fig. 3, *2*) the growth of the entire distal portion of the tail was completely arrested. The photomicrograph of the whole treated region (Fig. 4) shows the typical appearance of the tissues of the "zone of inhibition." In this illustration it is possible to see a transition from one zone to another.

The giant cells (macrophages or polyblasts) which are so characteristic for the "zone of inhibition" are wandering ameboid cells developed from histiocytes or resting wandering cells. The majority of giant cells are 40–60 microns in length, but there are some which measure 120 microns. The connective tissue cells of the animals of the same age were about 10–15 microns in length. Many previous observations have shown that the macrophages phagocytose all damaged cells of the irradiated region. For example, the reduction of an irradiated regenerating limb of an adult axolotl (Brunst[3,5]) occurred by means of the activity of these cells. Phagocytosis after roentgen irradiation was observed not only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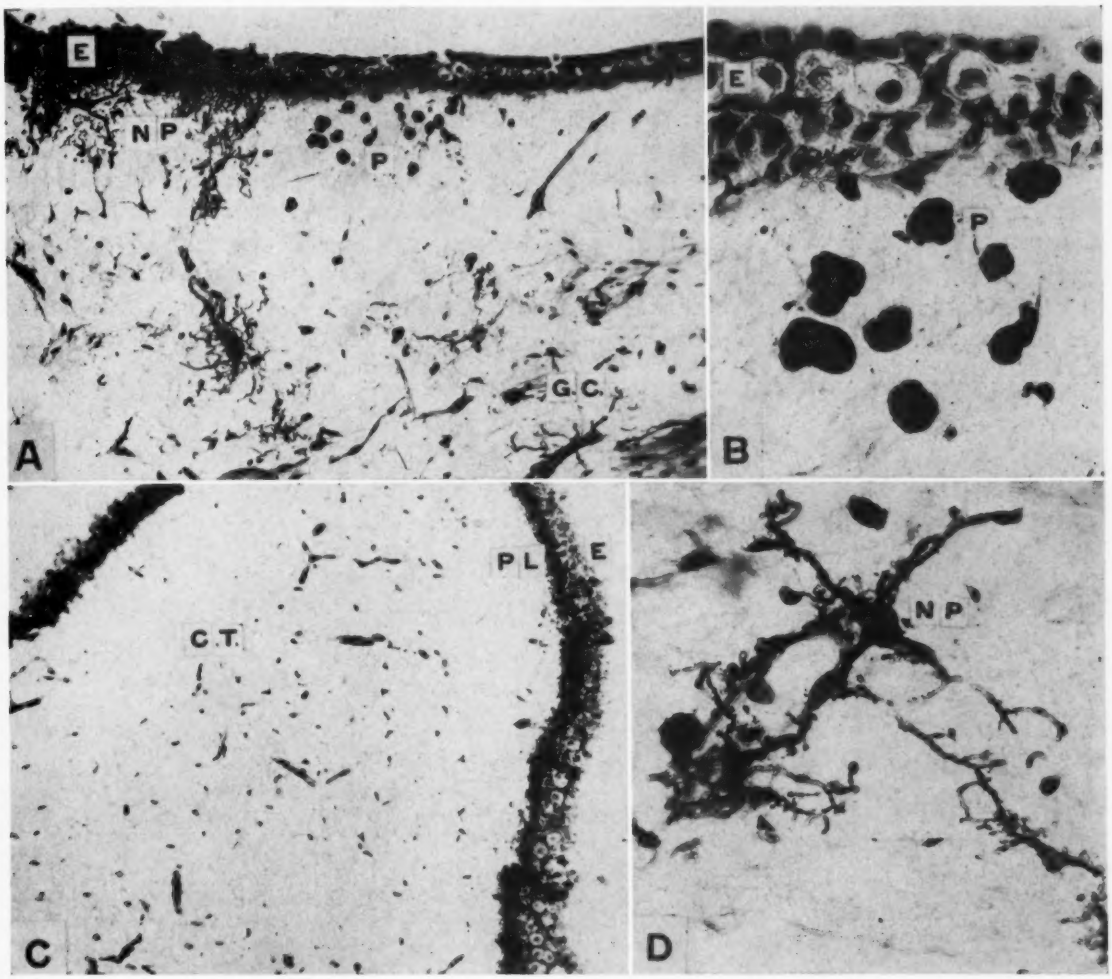

Fig. 6. Degeneration of the pigment layer of locally treated axolotls. (*A*) Partial degeneration of pigment layer in the "zone of inhibition" of an axolotl forty-seven days after irradiation with 1,200 r (57 days after hatching). Photomicrograph ×70. (*B*) Part of the same section at greater magnification (×280), showing degenerated pigment cells. (*C*) Normal pigment layer of a control animal of the same age as in (*A*) (57 days). Photomicrograph ×70. (*D*) An isolated pigment cell having a normal appearance in the treated region forty-seven days after irradiation with 1,200 r. Photomicrograph ×280. CT, connective tissue cells; E, epithelium; NP, normal pigment cell; P, degenerated pigment cell.

←

Fig. 5. The primary acute reaction to irradiation in tissues of locally treated axolotls. (*A*) Tissues in the "zone of inhibition" forty days after irradiation with 1,200 r. Photomicrograph ×70. (*B*) Part of the same section at a larger magnification (×280). Comparison of giant cells (macrophages) and ordinary connective tissue cells. (*C*) Tissues in the "zone of inhibition" of an animal thirty-one days after irradiation with 750 r. Photomicrograph ×322. (*D*) Tissues in the proximal (non-treated) region. Photomicrograph ×70. (*E*) Tissues in the "zone of inhibition" of the same animal as seen in (*D*) forty-five days after irradiation with 1,200 r. Photomicrograph ×70. (*F*) Tissues of a control animal of the same age as that in (*D*) (55 days). Photomicrograph ×70.

B, blood vessels or capillaries; CH, notochord; CT, connective tissue cells; E, epithelium; G, giant cells (macrophages); P, pigment cells (degenerated cells are globular; normal ones have processes).

in tissues of amphibians, but also (Warthin[46,47]) of white mice, rabbits and later in the tissues of human subjects. According to Cramer,[14] phagocytosis was also observed in irradiated mouse carcinoma. Observations of the latter author showed that the damaged cells attract the macrophages and that irradiation induces a macrophage reaction in the treated tissues. In our observations, various inclusions in the protoplasm of macrophages were observed. They appear to be the result of phagocytosis (Fig. 5, *B*, *C*). The photomicrographs show various shapes, sizes and typical location of macrophages in the treated tissues (Fig. 5, *A*, *B*, *C*, *E*). In most cases, macrophages can be observed in the maximally damaged tissues of the "zone of inhibition." In the surrounding tissues, there can always be observed degenerated pigment cells and typical "empty" spaces without cells (Fig. 5, *A*, *E*). The appearance of such tissues contrasts greatly with normal tissues of the more proximal part of the same animal (Fig. 5*D*) or with the normal tissues of control animals (Fig. 5*F*).

The general condition of the pigment layer in the treated region differs greatly from that in the control animals (Fig. 6*C*). One of the most permanent signs of primary acute reaction to irradiation is the degeneration of the pigment layer caused by a decrease in the number of pigment cells and changes in their shape. Instead of showing their typical form with numerous processes they become globular. The first sign of an irradiation effect is the presence of degenerated pigment cells. In some cases these cells were observed, not only during the primary acute reaction to irradiation, but some time after this period. In some areas of the treated region, the pigment cells completely disappeared; in other places, an accumulation of degenerated pigment cells was observed (Fig. 6, *A*, *B* and Fig. 2, zone C_1). However, in some parts of the treated tissues it is possible to observe normal pigment cells (Fig. 6, *A*, *D*). The changes in the pigment after

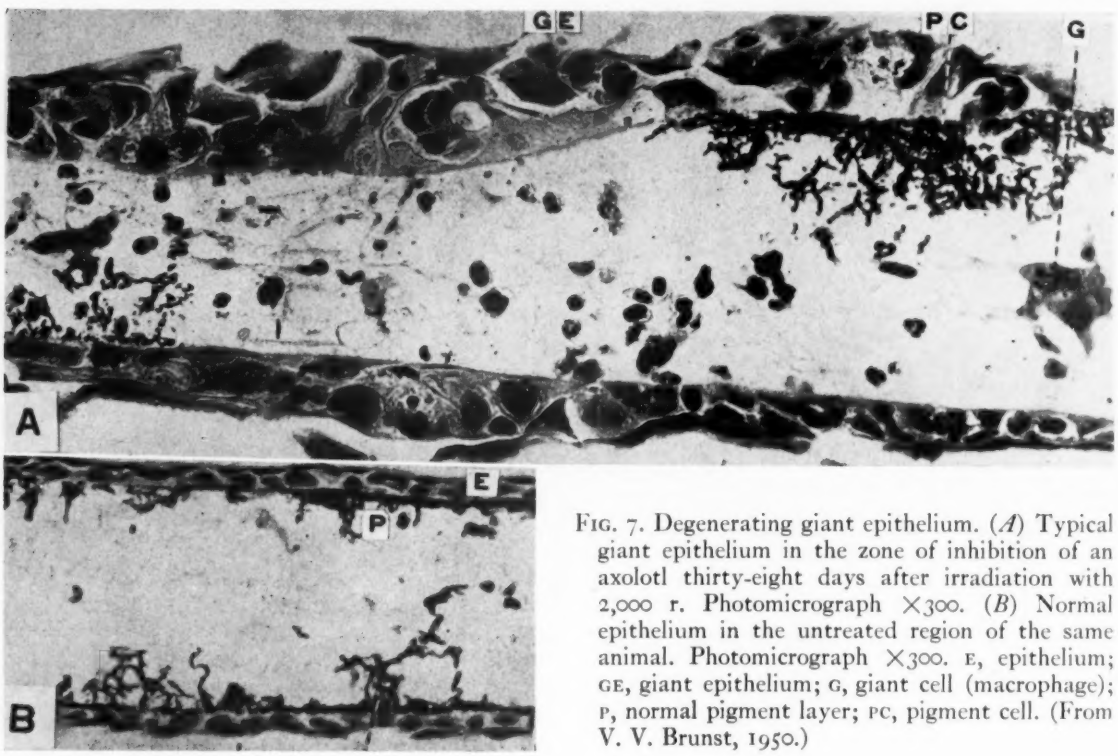

FIG. 7. Degenerating giant epithelium. (*A*) Typical giant epithelium in the zone of inhibition of an axolotl thirty-eight days after irradiation with 2,000 r. Photomicrograph ×300. (*B*) Normal epithelium in the untreated region of the same animal. Photomicrograph ×300. E, epithelium; GE, giant epithelium; G, giant cell (macrophage); P, normal pigment layer; PC, pigment cell. (From V. V. Brunst, 1950.)

roentgen irradiation is a characteristic biological reaction which has been described by numerous authors (Colwell, Thomson and Wakeley,[13] Levine,[26] Smith,[40,41] Scheremetjewa and Brunst,[38,39] Brunst,[3,4,6,7,8,9] Ellinger,[17] Welander *et al.*,[50] Luther,[32] and others).

The degeneration of the epithelium is also characteristic for the primary acute reaction to irradiation. Such a degenerating epithelium consisted of very large cells with large nuclei and was observed in various treated parts of amphibians (Grasnick,[19] Scheremetjewa and Brunst,[38] Brunst[3,5,7,9]). Formation of giant cells in treated tissues was described also in squamous cell carcinoma of the mouth and in oropharynx in the human subject (Hall and Friedman[21]) and in mouse carcinoma (Cramer;[14] see also Ewing,[18] Luther[30]). According to Brunst[9] the maximal height of the giant degenerating epithelium is five times greater than the maximal height of the normal epithelium. Gradual separation of cells or cell complexes is usual for the degenerating epithelial layer (Fig. 7). But in the present material fixed during the primary acute reaction to irradiation, the degenerating giant epithelium was not observed. All other symptoms of primary acute reaction were observed. In connection with this, it is important to compare the data of the effects of roentgen rays upon regeneration and development during the primary acute reaction obtained in various investigations. Table 1 shows that this reaction was observed in every investigation except one. In this one in-

TABLE I

COMPARISON OF DATA OF VARIOUS INVESTIGATIONS ON THE EFFECTS OF ROENTGEN RAYS UPON REGENERATION AND DEVELOPMENT DURING PRIMARY ACUTE REACTION

Subject of investigation	Influence of roentgen rays upon:						
	Tail regeneration in tadpoles of *Pelobates fuscus*	Limbs regeneration in adult axolotls	Development of the part of the body in young axolotl	Tail development in young axolotls	Limb development in young axolotls		Tail development in young axolotls
Authors and year of publication	Scheremetjewa and Brunst (1933)	Brunst (1938, 1944)	Brunst (1941, 1944)	Brunst (1948, 1950)	Brunst (1949, 1950)		Brunst, Barnett and Figge (present work)
					Preliminary experiments	Main experiments	
Days after irradiation when primary reaction was observed	30	43	— *1	35–40	20–35	22–36	23–28
Duration of primary reaction	— *2	— *2	— *1	— *2	30–40	30–40	40
Inflammation	X	X	— *1	X	X	X	X
"Zone of stimulation"	—	—	— *1	X	X	—	X
Giant cells (macrophages)	—	X	— *1	X	X	X	X
Degenerating giant epithelium	X	X	— *1	X	X	X	—
Reduction of pigment layer	X	X	— *1	X	X	X	X
Suppression of mitotic activity	X	X	X	X	X	X	X

*1 In this work fixations were made 90 days after irradiation. Therefore primary acute reaction to irradiation was not observed.
*2 This problem was not investigated.
X—was observed; —was not observed.

vestigation, the fixation was made ninety days after irradiation while in all others it was done earlier. In the experiments described in Table 1 the beginning of acute reaction was observed not earlier than

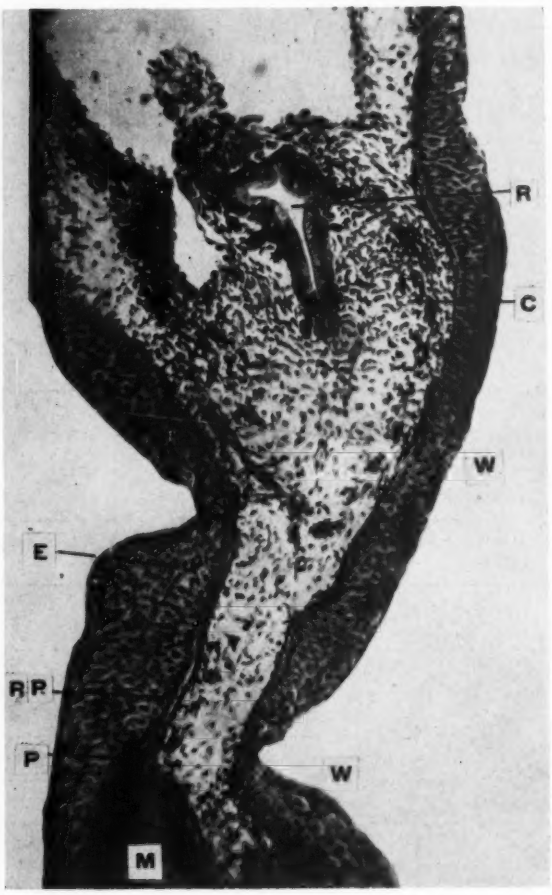

FIG. 8. Recovery of the treated tissues sixty-three days after irradiation with 1,500 r. C, connective tissue cells; E, epithelium; M, muscle; P, pigment layer in non-irradiated regions; RP, regenerating pigment layer in treated region; R, rectum; W-W, waist-like narrowing of the treated part of the body. Photomicrograph ×322.

twenty days after the irradiation. The reaction always disappeared (see below) in approximately forty days. However, other conditions of irradiation and use of large doses may make it possible to observe this tissue reaction much earlier. For example Rugh[37] used total body irradiation of amphibian larvae with very large doses (15,000 r) and observed tissue reaction (suppression of mitotic activity, degeneration of cells) seven days after irradiation. Koller[25] observed some changes twelve hours after irradiation with 3,000 r, but "no significant reaction is induced in the connective tissue below 3,000 r" (Koller,[25] p. 89). The formation of the "zone of stimulation" may be observed only for a very short time. Consequently, if the material was not fixed at the proper period the signs of stimulation could not be found. The absence of the degenerating epithelial layer was noted only in the material of the present paper. The real cause of this is not known. This problem must be reinvestigated.

The primary acute reaction disappeared slowly and gradually. For example, in cases in which a giant degenerating epithelium was revealed during the primary acute reaction, an epithelium of normal structure and decreased number of giant cells (polyblasts or macrophages) were observed forty to fifty days after irradiation of lumbosacral region of axolotls (Brunst[8]).

The changes in coloration of the treated region observed in the present material were also very typical. After irradiation with 1,200 r the maximal depigmentation of the treated region was observed forty days after treatment (Fig. 1*A*). New pigmentation of the treated region commenced fifty-two days after irradiation, was almost normal in fifty-nine days, and was completely normal in eighty-one days (Fig. 1*B*). The condition of the pigmentation depended upon the progress of the primary acute reaction to irradiation. It was described above that during this reaction almost all tissues of the treated region were damaged to some degree, and many cells degenerated completely. It is possible, therefore, to refer to this period as a period of "visible injuries." But about sixty days after treatment all damaged cells had died and disappeared (by means of the activity of the macrophages). All other cells recovered and had at this time a completely normal appearance. The secondary stable state began at this time. The photomicro-

graph (Fig. 8) shows the appearance of tissues of a treated animal fixed sixty-three days after treatment. The pigment layer apparently grew into the treated portion from the neighboring untreated region of the body. In spite of the normal appearance and cutaneous sensitivity. Following amputation in the distal (not treated) region there was a 100 per cent completely normal regeneration. However, after amputation in the treated region, regeneration was inhibited in 100 per cent

TABLE II

COMPARISON OF DATA OF VARIOUS INVESTIGATIONS ON THE EFFECTS OF ROENTGEN RAYS UPON REGENERATION AND DEVELOPMENT DURING SECONDARY STABLE STATE

Subject of investigation	Influence of roentgen rays upon:						
	Tail regeneration in tadpoles of *Pelobates fuscus*	Limbs regeneration in adult axolotls and tritons	Development of the part of the body in axolotls	Tail development in young axolotls	Limb development in young axolotls		Tail development in young axolotls
Authors and year of publication	Scheremetjewa and Brunst (1933)	Brunst (1938, 1944)	Brunst (1941, 1944)	Brunst (1948, 1950)	Brunst (1949, 1950)		Brunst, Barnett and Figge (present work)
					Preliminary experiments	Main experiments	
Stable state was observed in the following period of time after treatment	— *1	70 days, 1–5 years	90 days	85–100 days	60 days	63–76	60–130
Permanent suppression of mitotic activity (suppression of growth, regeneration and development)	X	X	X	X	X	X	X
Normal appearance of treated tissues	— *1	X	X	X	X	X	X

*1 In this work fixations were made 6 and 30 days after irradiation; therefore secondary stable states were not observed.
X—was observed; —was not observed.

ance of these tissues, the mitotic activity and, therefore, the development and regeneration in the treated region were completely arrested ("invisible injuries"). This stable state was observed in all investigations (Table II), in which the animals were fixed sixty days or more after treatment. Local irradiation of an adult limb in triton or axolotl destroys its capacity to regenerate, but usually produces no visible changes in its appearance (Brunst and Scheremetjewa,[10,11,12] Scheremetjewa and Brunst,[39] Brunst[3,5,8]). For instance, irradiation with 4,000–15,000 r of the proximal region of hind limbs of *Triton cristatus* did not give a visible effect. The irradiated limbs retained their normal appearance and cutaneous sensitivity. Following amputation in the distal (not treated) region there was a 100 per cent completely normal regeneration. However, after amputation in the treated region, regeneration was inhibited in 100 per cent of cases. This observation shows that the inhibition of regeneration is the result of local damage of treated cells, but not of blood vessels in this region. In such a case, a normal regeneration in the distal region after irradiation of the proximal part is unlikely. If the amputation of the limbs is made two months after irradiation, in spite of the normal appearance of the treated region, regeneration is not observed (Brunst and Sheremetieva[10,12]). These results show that it is possible to destroy the regenerative ability without impairing the vital capacity of cells. According to Luther,[27,28,29] the skin cells are not injured in roentgen irradiated salamander larvae but mitotic activity was completely ar-

rested ("Sterelisierung") for long periods of time.

Similar results were obtained in experimental investigations in invertebrates. In *Tubularia crocea* the regeneration capacity may be suppressed, although the hydroid

FIG. 9. Inhibition of growth and development after local irradiation of part of the body with 5,000 r. (From V. V. Brunst, 1944.)

remains alive (Curtis and Ritter[15]). A treatment with a large dose of radium does not kill planarians, although cell division and regeneration are suppressed by much smaller doses (Weigand[50]). Irradiated *Tubifex* remained alive for 147 days despite a complete loss of regeneration capacity (Stone[42]). *Lumbriculus inconstans*, which was irradiated in toto, lost the regeneration capacity but remained alive for sixty days (Turner[46]). Irradiated Protozoa (trypanosomes, Paramecium, Polytoma, Polonium) retained their mobility and increased in size but they lost the ability to divide (Halberstaedter,[20] Back,[1] Holweck and Lacassagne[23,24]). The results of all these experiments show that a dose of radiation sufficient to suppress proliferation is much less than the lethal dose.

The problem arises as to how long irradiated parts of the body can exist with blocked cell division. In several adult individuals of *Triton cristatus* (Brunst,[5] Brunst and Scheremetjewa[10,12]) the proximal part of the right hind limb was irradiated with 7,000 r. During a period of a year no difference was observed in the appearance or function in the treated and the control limbs. After the amputation of both limbs, a normal regeneration of the

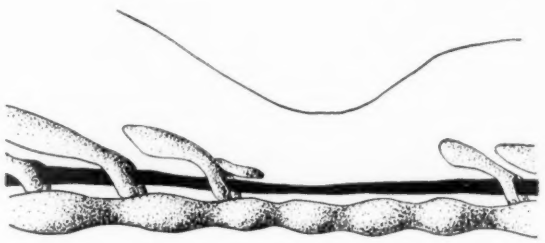

FIG. 10. Reconstruction of skeleton and neural tube of the animal shown in Figure 9. (From V. V. Brunst, 1944.)

control limb was observed while it was completely suppressed in the irradiated limb. These experiments showed that the alterations caused by irradiation in treated tissues are permanent. The altered properties of the treated limb became manifest only after the amputation, when a normal regeneration blastema failed to form.

A different picture was observed in young amphibian larvae when a part of the body was irradiated. Irradiation of the tail resulted in suppression of its growth (Fig. 1 and 3) and irradiation of the middle portion of the body resulted in formation of a more or less pronounced waist-like narrowing in the treated region caused by suppression of growth and development (Fig. 8, 9 and 10). Generally, if an organ is irradiated after its anlage has formed, its development continues for some time (possibly during the latent period) and later is completely arrested (if the dose was large enough). If the animal was irradiated before the formation of the anlage of the organ, development does not occur (Fig. 10). For example, after irradiation of the

lumbosacral region of young axolotls, the animals can live for a long time, but the development of hind limbs does not occur (Brunst[6]).

Treated tissues can survive for a very long time. For instance, the hind limb of *Triton cristatus* was locally treated with 4,000 r. Three months after the irradiation, the distal part of the limb was amputated, but no regeneration took place. Eight months after the irradiation, a second amputation at a more proximal level was made. The histological investigation of the amputated piece showed that the place of the first amputation is clearly visible (Fig. 11*A;* surface *A-A*), because the distal edge of the severed bone remained without change and showed no sign of regeneration of bone or cartilaginous tissues. The distal surface (*A-A*) of the stump was covered

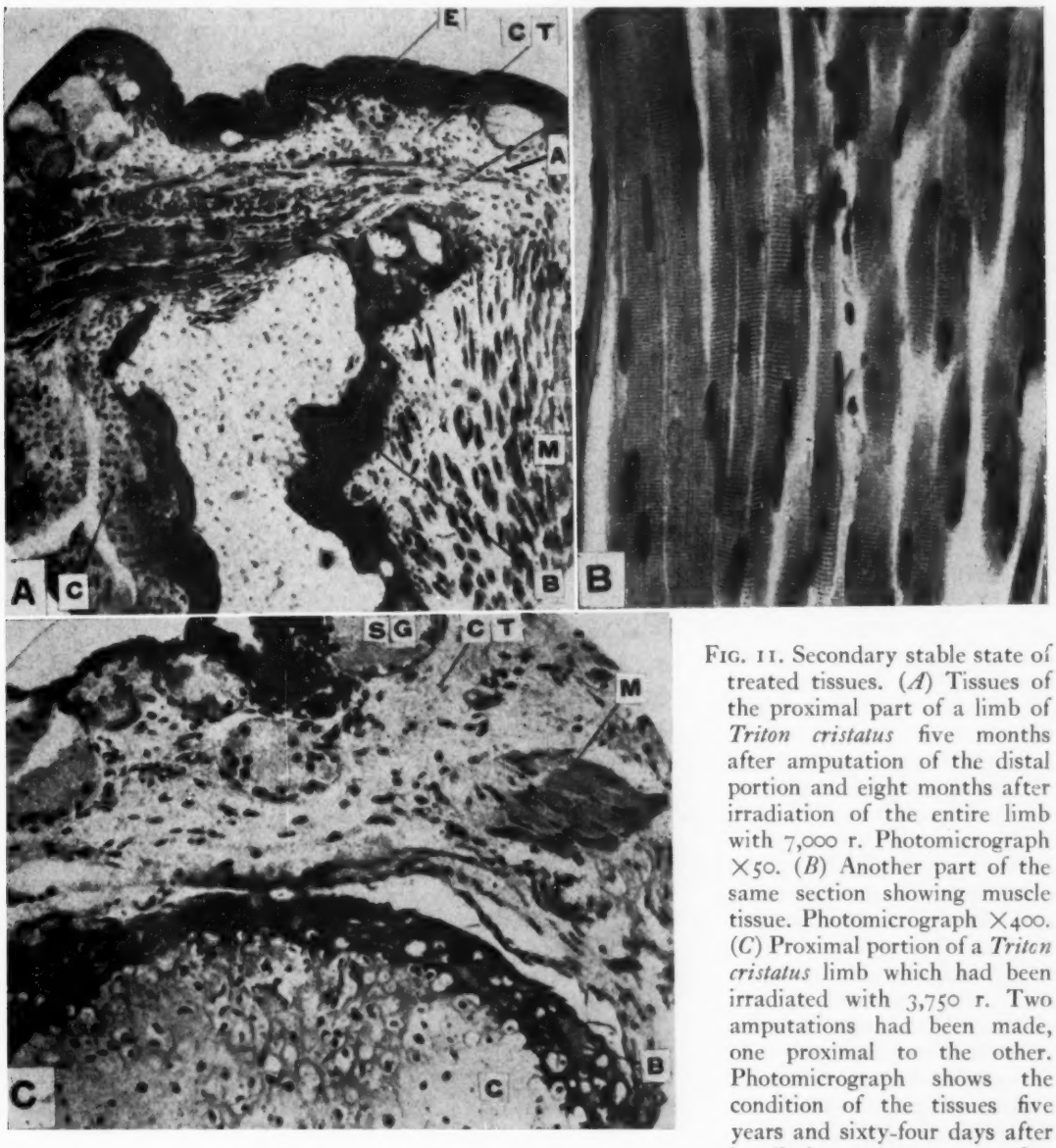

Fig. 11. Secondary stable state of treated tissues. (*A*) Tissues of the proximal part of a limb of *Triton cristatus* five months after amputation of the distal portion and eight months after irradiation of the entire limb with 7,000 r. Photomicrograph ×50. (*B*) Another part of the same section showing muscle tissue. Photomicrograph ×400. (*C*) Proximal portion of a *Triton cristatus* limb which had been irradiated with 3,750 r. Two amputations had been made, one proximal to the other. Photomicrograph shows the condition of the tissues five years and sixty-four days after irradiation and two years after a second amputation. A-A, level of first amputation; B, bone; C, cartilage; CT, connective tissue; E, epithelium; M, muscle; SG, subcutaneous glands. (From V. V. Brunst, 1944.)

with a normal epithelium under which was a small amount of connective tissue, a few striated muscle fibers and blood vessels. It is necessary to emphasize that the appearance of treated tissues does not differ from the tissues of control animals. The striated muscles possess the typical cross striations, longitudinal fibers, and the nuclei look normal (Fig. 11*B*). Mitotic figures were not found in any tissues except the epithelium. Obviously the irradiated tissues retain their normal appearance for a long time. For example, in a *Triton cristatus* normal looking tissues were found without regenerative capacity for more than five years after the irradiation. Five years of a triton's life is equivalent to not less than twenty years of a human subject's life. No regeneration took place in this animal after two amputations. The skeleton of the limb was shortened to only the proximal epiphysis of the femur (Fig. 11*C*). No mitoses were found (Brunst[3,5]).

Some authors have pointed out that no visible structural changes are seen in the irradiated tissues; nevertheless, the cells of these tissues have lost the ability to divide and the organs their ability to regenerate and to grow. A histological study of the treated septa of *Tubifex* showed no visible alterations, although they had lost the ability to form neoblasts (Stone[42]). No changes in somatic cells have been found in planarians dying one month after irradiation but mitotic figures were absent and sex cells showed signs of degeneration (Bardeen and Baetjer[2]). Irradiated rat spermatozoa remained morphologically normal, but incapable of giving rise to viable offspring (Wattenwyl[49]).

The idea that roentgen irradiation only kills and destroys a number of tissue cells is very prevalent. For example, according to Koller[25] " . . . both normal and malignant cells can be injured and killed by a therapeutic dose (100–600 r) through radiation induced damage to the chromosome mechanism. Death occurs at mitosis." According to Luther[30] the end result of roentgen irradiation is complete or partial destruction of the treated tissues. On the contrary, our observations do not confirm his results. It is impossible to explain our results by special sensitivity of endothelial cells and, as a result of this, an excessive hyperemia, extravasation of blood and intravascular thrombosis (Pullinger[36]) (see also Koller[25]). It appears that only one hypothesis explains most of the well established facts: If the dose was not high enough to kill the cells outright, the roentgen rays produce no irreversible lethal changes in the cells. They do, however, produce subtle irreversible changes in the cells, probably in the nuclei, which result in the suppression of mitotic activity.

The effect of roentgen irradiation in tissues (during the stable state) is not visible with the usual histological technique. But it is possible that, by the application of another method, we may be able to see some alteration in the treated tissues and especially in the nuclei of treated cells. The use of the Feulgen reaction to thymonucleic acid showed that roentgen irradiation really stimulated some fine alterations in nuclei of treated cells (Mitchell,[33] Errera,[17] Koller,[25] Stowell,[43] Holmes,[22] Taylor, Greenstein and Hollaender,[44,45] and others). It is possible that this method will lead to a real understanding of the biological effect of roentgen irradiation.

SUMMARY

The first effects of the irradiation (under the conditions employed by the authors) become evident twenty to twenty-eight days following treatment. This indicates the beginning of the primary acute reaction which is typified by inflammation, the presence of active giant cells (macrophages or polyblasts), degeneration of epithelial and pigment layers and the suppression of mitotic activity. This reaction lasts for approximately forty days. Sixty days following treatment and thereafter, there is observed the secondary stable state. Typical of the state is a normal appearance of all the tissues and a supres-

sion of mitotic activity. Therefore, development and regeneration in the treated portion are completely arrested. This stable state continues through the remainder of the life of the treated animals. For example, the normal appearing irradiated tissues of *Triton cristatus* with suppressed capacity for regeneration were found more than five years after treatment. This span of years of triton life is probably equivalent to about twenty years in the life of a human subject.

The effects of the roentgen irradiation on tissues (during the stable state) is not rendered visible by the usual histological technique.

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THE TRAINING OF RESIDENTS IN RADIOLOGY*

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WE ARE here to discuss one of our most important problems; namely, the training of those who are to become our assistants, colleagues and successors in the practice of radiology. Unanimous agreement in our views is not to be expected, but disagreement should lead to more thorough debate and greater illumination of moot questions. To secure maximal enlightenment I have asked some of our outstanding teachers and authorities in various fields of radiology to take part in the discussion. Therefore, I shall not go into the details of training in radiology. To introduce the theme of our symposium, however, I should like to recount some of the historical background of radiology, particularly the part that has been played by the American Board of Radiology, which from the beginning has been more responsible than any other single agency for setting up minimal standards of graduate education in radiology. I shall review its activities without embarrassment, for it is your organization as much as mine. It is your creation and agent, readily responsive to the consensus of American radiologists, definitely including yourselves.

When the Board was first organized in 1934 the consensus among the trustees of the Board was that after a certain date we would certify candidates in one field only, that of Radiology, which was to cover the entire related domain. Before that date arrived, however, our thinking changed and we provided for certification of candidates in any of six fields; namely, Radiology, Roentgenology, Diagnostic Roengenology, Therapeutic Roentgenology, Therapeutic Radiology and Radium Therapy. Soon, however, it was felt that certificates should not be granted in either Therapeutic Roentgenology alone or Radium Therapy alone. Consequently certification was, and continues to be, confined to four categories: Radiology (general and all-inclusive), Roentgenology (diagnostic and therapeutic), Diagnostic Roentgenology, and Therapeutic Radiology (roentgen-ray and radium therapy).

When this program was instituted, and for a considerable time thereafter, it was thought by some that we should strive for adoption of the single broad certificate in Radiology. But views have changed and it is now the unanimous opinion of the Board that we should not abolish certification in Diagnostic Roentgenology or Therapeutic Radiology if the candidate proposes to practice only the one or the other, although the Board still holds that we should retain certification in Radiology in general, just as the surgeons tenaciously maintain certification in general surgery. Some critics object to certification in Roentgenology, which includes roentgenologic diagnosis and therapy but excludes radium therapy, on the ground that the practitioner also should be familiar with the potentialities and application of radium and thus be able to advise in the choice of the most desirable agent in a given case. We also should take note that radioisotopes will undoubtedly soon become an integral part of radiotherapy and thus further complicate plans for training and certification.

Certain inequities are connected with certification in portions only of the radiologic field. If the candidate applies for instruction in any one of the four categories now recognized, he is required to take a minimum of three years' training in that branch. On the other hand, if the candidate receives training for three years in the entire field of Radiology and fails to pass the examination in certain branches, he

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may, if he so elects, take a certificate in the branch in which he has been successful in passing. This is manifestly unfair, for as a student of general radiology he may have devoted but one year to the branch in which he is granted certification, whereas a candidate who chooses that field at the outset must devote a full three years to it in order to be eligible for certification. Many who accepted partial certification in order to qualify for a job would return within a year for re-examination in the field in which they failed. To encourage a candidate who has been trained in general radiology not to accept partial certification, a rule was made requiring him, if he does accept a partial certificate, to wait at least two years before becoming eligible for re-examination. This still does not eliminate the unfairness of limited certification in such instances, so now we also require the candidate who accepts a partial certificate to furnish a signed statement that at least 90 per cent of his practice is or will be in the branch for which he is certified.

Closely related to the problem of certification in separate branches of radiology and providing appropriate instruction in those branches is the proposal to divide radiology into two independent specialities: Diagnostic Roentgenology and Therapeutic Radiology. This has been strongly advocated by some of our distinguished colleagues and their opinion is entitled to respectful consideration. In support of the proposal it is argued by some that the two branches have nothing in common except the apparatus employed.

I freely concede that such separation will almost certainly occur sometime in the future as a natural step in the further evolution of radiology. Indeed it may well be that the present tentative and temporary recognition by the American Board of Radiology of four branches represents the beginning of a far-distant stage in the development of our specialty. I admit also that even now large institutions with abundant material are fully warranted in their practice of definitely separating diagnostic from therapeutic services and giving intensively specialized instruction in either or both branches.

Nevertheless, I feel strongly that the establishment by decree of two independent radiologic specialties at this time, however logical their separation may seem, would be premature, impractical and unrealistic. A great majority of us, by choice or necessity, are, and our successors will probably continue to be for some time, general radiologists. Most hospitals and teaching institutions require their chief or sole radiologist to practice and teach the specialty as a whole. Finally, an overwhelming majority of general radiologists would indignantly refuse to give up their work in either branch. For these reasons, few graduate students in radiology, whether they expect to work in an institution or to practice individually, will confine their study to a limited portion of the field. For example, I have canvassed the latest 338 applications received by the Board and find that 2.9 per cent of the candidates applied for certification in Therapeutic Radiology alone and 3.8 per cent applied for Diagnostic Roentgenology alone. This means that not nearly enough men are entering the fields of therapeutic radiology or diagnostic roentgenology to warrant dividing the broad specialty at this time.

It seems to me that those of us who are interested primarily and chiefly in therapy might strive to influence student candidates to confine their attention to this field by convincing them of its merits, and after a considerable proportion of aspirants have been obtained we can then begin to talk about setting up an independent specialty. As one item in this program I think the fact should be emphasized both by precept and example that therapeutic radiologists, particularly those concerned with radium therapy, can do a better job of treating with radium than many surgeons who continue to perform much of this work. I am confident that Dr. Quick and those who will follow him in the discussion will have some of the answers and

offer constructive suggestions regarding instruction in therapeutic radiology.

After hearing the three distinguished speakers who follow, I am sure we shall all return home with renewed enthusiasm and a determination to assist in raising the standards of radiology by improving our training of those who are to be our successors.*

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* For discussion see page 456.

THE TRAINING OF RESIDENTS IN ROENTGEN DIAGNOSIS*

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ON THIS the Fiftieth Anniversary of the founding of the American Roentgen Ray Society it is fitting to contemplate the growth of graduate teaching in radiology from its very roots to the expansive flowering plant which now boasts of almost a thousand buds and each year produces some three hundred and fifty blooms of more or less mature fruition and more or less beauty. What has been the course of graduate instruction during this time? Has it, like Topsy, "just growed" or has it followed a specific pattern. I think it has grown in a pragmatic, opportunistic fashion and it is well that this has been its course. For a more rigid, uniform program may be good in its immediate effect, but, becoming inflexible, it is soon outgrown by the march of events. Here there has been little programming. We have been opportunists in the best sense of that word, changing at need, grasping at improvements, adjusting ourselves to new circumstances. In a country such as ours, of such a varied geography, economics, people, there may be marked differences in methods of education. Certainly any course of study in the graduate field must adjust itself to the realities of the institution in which it is given. The size, location and character of that institution will materially modify the nature of the training program.

Roentgen diagnosis is unique among the specialties—it cuts squarely across all the divisions of medicine. The radiologist has been truly called the general practitioner amongst the specialties. While this, no doubt, enhances the attractiveness of the field, at the same time it makes necessary a broad knowledge of all the medical specialties. This is so true that in recent years there has been a great trend in the direction of specialization within the specialty. Aside from the trend toward a separation of diagnosis from therapy, which will be considered by another essayist, there have appeared divisions of roentgen diagnosis itself. Such divisions are becoming prevalent in Sweden to some degree; in Japan they have been in effect to a very considerable degree; in Germany and Austria, likewise, there were many specialties within this specialty. The tendency has been less marked in this country but we now have pediatric, neurologic, otolaryngologic, and orthopedic roentgenology. Recognizing the necessity for this trend because of the complexities of medical practice, we must nevertheless adhere to a program in which the resident receives a general training in roentgen diagnosis before he enters into one of the specialties. If he is to become a neurological roentgenologist or a pediatric roentgenologist he should enter this specialty through the door of a general fundamental radiologic training. It is true that occasionally one finds in one of the other medical specialties an individual who develops an unusual aptitude for radiology as concerns that specialty alone. Such an individual, given a good background of general radiological training, with particular emphasis on the fundamentals of radiology, may be likely to expand the field to its best degree.

A roentgen diagnostician must, therefore, have a thorough familiarity, a comprehensive knowledge of all the branches of clinical medicine. In fact, he must first of all be a clinician himself, approaching roentgen diagnosis with the patient, an individual, in his mind. Nothing is more

* From the Department of Radiology and Physical Medicine, University of Minnesota Medical School, Minneapolis, Minnesota. Presented in a Symposium on The Training of Residents in Radiology at the Fifty-first Annual Meeting, American Roentgen Ray Society, St. Louis, Mo., Sept. 26–29, 1950.

important in the training of the roentgen diagnostician than the development of this spirit. It is so easy, because of the long hours spent with films, or in the roentgenoscopic room where the anonymity of the patient so detracts from personal contact, to divorce roentgen diagnosis from the living patient. Such a divorce would be disastrous. Furthermore, the resident must be prepared to accept clinical responsibility, to assume that his diagnosis may be crucial in the conduct of the patient. He must not shift one iota of his responsibility to any other specialist or to the referring physician. It is true that the referring physician must, in the final analysis, decide as to the course for his patient, but in his consultation the roentgen diagnostician must assume that the decision may well be based largely upon his findings. Certainly in the training of roentgen diagnosticians more attention should be paid to their relationships with their colleagues. In the final analysis the average radiologist, particularly the roentgen diagnostician, has more contacts with his medical colleagues than he does with patients; a cultivation of the ability to converse in the language of each of these colleagues, to have consideration for their desires and ambitions, in fact, to have consideration for their foibles is an integral part of the position of a consultant and should be cultivated in the residency. The ethics of medical practice should be brought out by the example furnished the resident within the department in which he is training.

I will not go into any detail concerning the prerequisites which the resident in radiology should have. I would observe, however, that a few years in general practice is highly desirable; a year spent in pathology or internal medicine is of very great value as a prerequisite to entrance into the field of roentgen diagnosis. I would not demand such prerequisites since we do not wish to prolong the period of education unduly, but when a choice of applicants is presented, any of these should be considered as highly desirable.

More or less arbitrarily we have struck upon three years as a minimum training period in radiology. It should be understood that this is not universal. In Sweden, for example, five years is now miminum; in Japan, five to six years. In this country, too, longer periods are demanded at some institutions. Many of us have been reluctant to recommend any marked increase in the period of residency because the time spent in medical education is already too long. The ratio between the period of preparation and the period of productivity is already far too low. Secondly, the demand for well-trained radiologists still so far exceeds the supply that we should not reduce the flow until this demand has been more completely saturated.

The division of the three years between diagnosis and therapy has been widely discussed; two-thirds of the time devoted to diagnosis and one-third to therapy appears to be the most commonly accepted arrangement. This seems to be a fair division, considering the educational needs, the ramifications, and the degree of utilization of each field in actual practice. I should emphasize again that all of these periods are minimal. In many institutions, provision is made for a fourth and even a fifth year to permit selected residents to pursue either diagnosis or therapy to a much fuller extent. The matter of separate training for each division will be discussed elsewhere. In any case, if the individual devotes himself to roentgen diagnosis alone, three years should still be spent, as the two years is certainly a minimum.

Fundamentally, graduate training in all fields of medicine should be regarded as a preceptorship rather than in any didactic sense. The resident is a mature individual with an extensive education already behind him. Most of his learning, therefore, should be acquired by his own efforts, guided but not administered. No curriculum for the graduate student should be rigid. What is important is to make available to him the means of acquiring knowledge, the opportunity to gain facility with

that knowledge. Furthermore, we should feel that the period of residency cannot encompass all the education in roentgen diagnosis—it is but the beginning of that education. Further study, repetition of ideas, of procedures and, above all, experience must be gained after the period of formal training.

The roentgen diagnostician, in addition to his broad familiarity with all the fields of medicine, is distinguished from other physicians by certain specific knowledge. This knowledge must be acquired largely during his period of formal training by means of lectures, demonstrations, laboratory experiments and practical work in the roentgen-ray department. I cannot take time to describe the details of all of these courses of study, but I would list here the basic requirements:

1. *Biophysics, that is, the physics of roentgenography and roentgenoscopy.*

In the urge to learn the physics of radiation therapy, the importance of the basic physics of roentgen diagnosis is often overlooked. Yet this is very important knowledge which every radiologist should be thoroughly familiar with for it permits him to understand why certain things happen in the roentgenoscopic room, why certain things happen to certain roentgenograms, and gives him a much better opportunity for advancing in his field.

2. *The mechanics and electrical construction of roentgenologic equipment.*

3. *The technique of roentgenography.*

This is, likewise, too often neglected and should be given a distinct part in the program of graduate training. Lectures and demonstrations in this field are of great value, but the resident must also have at least several months of practical work in the department. Furthermore, the assignment of the resident to emergency technical work is of great value in creating an independent knowledge of this field.

4. *The technique of roentgenoscopy.*

This can well be taught by personal demonstration of the methods. Facility in roentgenoscopy, however, can only be acquired by doing, by experience.

5. *The technique of the analysis of the roentgenogram in terms of density followed by the technique of roentgen interpretation.*

Both of these fields have specific data which can be communicated to the residents in addition to the practical experience which they should have.

6. *Normal anatomy is a keystone for roentgen diagnosis and, when possible, courses in topographic anatomy and dissection of the lung should be given.*

While such courses are readily available in graduate teaching programs that are connected intimately with a medical school, they can also be approximated by work within any roentgen department. Roentgenography of known normals, the study of cadavers with contrast media, the availability of skeletons, anatomical models and atlases will make it possible for the resident to acquire such knowledge specifically.

7. *Normal roentgen antomy should be correlated with normal gross anatomy.*

Particularly important is it that there be a good film library of anatomical variations and anomalies for study on the part of the graduate student.

8. *Physiology is one of the most neglected of the basic studies which are important toward an understanding of roentgen diagnosis.*

The number of graduate students appearing for the American Board of Radiology examinations who have almost no knowledge of the physiology of respiration or of the circulation is most astonishing. It is obvious at once how important the knowledge of pathological physiology of the cardiovascular system is toward an understanding of the roentgen diagnosis of heart disease, yet too few graduate students are stimulated to obtain such knowledge. Even such fundamental information as the physiologic mechanism underlying cholecystography is frequently not known. Here, again, courses in normal physiology can be obtained in medical

schools, but textbooks of pathological physiology and lectures in this field, on the part of the staff of a roentgen department, can convey this information effectively to the residents.

9. *Pathology is an important part of the graduate curriculum in radiology.*

At least six months of the resident's three year period should be devoted to the study of pathology, either full time or distributed in sufficient hours through the residency period to equal this amount. Whether this should come at the beginning, the end, or in the middle of the residency has always been a moot question. Certainly a resident is better prepared for roentgen diagnosis if he has had full time study in a department of pathology. On the other hand, he will appreciate the importance of pathology far more after he has had a considerable experience with roentgen diagnosis. It seems to me that either method is desirable and no doubt the time when pathology is studied will depend upon the facilities of the institution.

I would emphasize the importance of teaching the residents in radiology the translation of the nomenclature of pathology into the terminology of roentgen diagnosis. The use of purely roentgenologic terms such as "shadow," "density," etc., is good for descriptive purposes but in the final analysis we must be able to convert such terms into the more universal language of anatomy and pathology. Just as one designates the rounded shadow in the left superior mediastinum as the aortic arch, so a gross enlargement of that shadow should be designated as an aneurysm. I believe the resident should be taught roentgen interpretation in terms of gross pathology which the roentgen densities represent. If it is impossible to specifically designate any shadow as representing a particular pathologic condition then it should be so stated.

10. *Roentgen interpretation is both a science and an art.*

The science can be taught to some degree by lectures, demonstrations and personal instruction. The art must be acquired by self instruction. Facility with both science and art must be obtained by doing. No amount of observation of the work of others can effectively teach the resident to interpret films or to do roentgenoscopy. One can no more learn roentgen interpretation by watching over someone's shoulder than he can learn to do surgery by watching an operation. He must be given opportunity at the earliest moment to do both of these independently. The actual interpretation of films and the roentgenoscopy of patients by the resident will, of course, lead to errors. To some degree this is unavoidable, for no residency is worth very much which does not permit wide utilization of the clinical material by the resident on his own.

When roentgen interpretation is done independently by the resident, it is important to have a number of checks and balances which will permit the elimination of error to the largest extent and the determination of the quality of the resident's work. A number of procedures are available in this regard. To begin with, interpretation should be done by the resident without recording on the patient's record. The staff in charge of this particular division then reviews the films with the resident and has opportunity to check his detailed reports before they are sent out. After a period of some three months of this type of indoctrination into the work, the resident may be permitted to make reports on his own. From this time on, a number of other procedures are undertaken. First of all, from day to day sampling is done of the resident's reports and in this way a determination of whether he is reasonably accurate in his diagnostic procedures can be determined. Secondly, we may rely on the numerous roentgen diagnostic conferences, which should be held in every teaching institution between the radiologists and the clinical staff. At such conferences many of the films which have already been reported will come before the radiologist for review

and if he arranges to have available to him the report of the resident at that time he can quickly determine errors and poor judgment. Thirdly, the resident is instructed to withhold reports on all films which are doubtful, somewhat out of the ordinary, or in which he is not certain of his findings. These are assembled daily for review by the staff. This daily exercise is of great importance in teaching roentgen interpretation as it brings to the fore most of the types of cases which are instructive and, at the same time, difficult.

One of the serious difficulties lies in the errors in negative diagnosis. Obviously, the resident will not retain for review by the staff a film which he considers to be unequivocally negative. Errors in this field, therefore, are likely to occur without the opportunity on the part of the staff to check them up. Therefore, it is in this group that sampling is of very great importance. Furthermore, in most teaching institutions follow-up examinations are most often made. A good rapport between the clinicians and the roentgen department will permit the clinician to request re-examination in cases called negative in which he is still suspicious of a pathological process. Under these circumstances the films should always be reviewed by the staff and thus other errors and misjudgment in the negative group can be discovered.

Roentgenoscopy represents a somewhat similar problem. It can be taught first by demonstration and then by observation of the resident while he himself is doing the roentgenoscopic examination. Finally, the resident must be introduced to detailed roentgenoscopic examination on his own. Much can be done, however, in eliminating errors in this field and in determining the quality of the resident's work by having a number of films, both of the thorax and of the abdomen, made on the cases examined by the resident. With a sufficient number of films, with re-examination done by the preceptor when there is any discrepancy between the roentgenoscopic findings which are recorded by the resident and the films which he observes, and with the re-examinations which are often done as follow-up studies, it is usually possible to check the work of the resident even though the preceptor is not directly present at the first examination. Here again, the negative examinations are a great difficulty but some risk must be undertaken if the resident is to have the opportunity to independently learn to make such examinations.

In our institution we begin the resident's study of roentgenoscopy by having him assist one of the staff, first in the roentgenoscopy of the chest, and then of the gastrointestinal tract. Every individual coming into the Out-patient Clinic has a routine examination of the chest, and the opportunity for critically examining the work of the resident after he has been doing this independently is afforded by reason of the fact that all of these patients also have photofluorography done and a great many of them have films of the chest done at the request of the clinical staff. In the case of the gastrointestinal tract, much the same procedure is followed. First, there is observation, then roentgenoscopy under observation and finally independent examination. But the resident makes certain spot films and certain routine films on every case, thus giving opportunity to the staff to review his work.

In this connection the matter of using private patients for teaching purposes must be considered. As one examines such a teaching program, at first glance it may seem to be suitable only for institutions catering to free patients. This is distinctly not true. Without doubt some of the best residents' training in this country is being given in institutions in which the vast majority of patients are private-pay patients. In roentgenology, especially, it is readily possible to use private patients for teaching purposes. The fact is that the ratio of private to free patients at teaching institutions and medical schools is rapidly increasing. With social security becoming more widely applied, with our economy

producing such a high level of income, a diminution in the number of free and an increase in the number of private patients will become more and more true. We must, therefore, educate the public to the idea and ideal that all patients should be used for teaching because they and their children will benefit from it; that a teaching institution practices better medicine, in general, and that, therefore, they should be happy to go to a teaching institution even though they may be examined by residents. Our experience with the Veterans Administration Hospitals has demonstrated this effectively. From an absolute refusal to permit even pathological specimens to be biopsied for study purposes, the Veterans Administration Hospitals have now advanced in many places to complete teaching institutions with both undergraduate and graduate students in large numbers; concomitant with this change has come far better treatment for the veterans in such institutions. From the training program of large private clinics and certain large private hospitals have come some of our best radiologists. It is easily possible to use private patients effectively for teaching residents in radiology if the program is properly approached.

11. *Clinical medicine for the radiologist can be learned in a number of ways.*

In some institutions the radiological resident is actually put on a rotating service among the major specialties, spending perhaps a year doing pediatrics, medicine, surgery, etc. Another method, however, and one which may be very effective, especially if there is not sufficient time for the procedure indicated above, is by means of intimate contact with these services. To accomplish this we use two methods. We have multiple conferences with the various clinical services at weekly intervals at which time the cases seen during the week are discussed, the treatment is analyzed, and the roentgen findings are correlated. Secondly, we assign some of our residents during certain periods of their training to the task of assisting in the staff viewing room. Here they come in close contact with the members of other departments, hear their problems discussed and learn how they affect the radiologist. In addition, the radiological resident attends as many exercises in the other departments as possible. In any hospital or clinic where there is good cooperation with the clinical staff, the radiological resident should be able to obtain a broad knowledge of medicine if he is willing to listen and observe.

A proposal for a program of didactic teaching during the two years of the residency devoted to roentgen diagnosis is given in Table 1. It should be noted that such courses should vary in time and in arrangement in various institutions, depending upon the availability of instructors and the duties of the residents. The hours shown here are only given as an outline of what seems desirable.

TABLE I

DIDACTIC COURSES
Lectures, Demonstrations, Discussions

First Year Weekly		Second Year Weekly	
Biophysics	1 hour	Pathology	2 hours
Anatomy	1 hour	Roentgen diagnosis	2 hours
Physiology	1 hour	Discussion—Quiz	1 hour
Pathology	1 hour	Seminar	1 hour
Roentgen technique	1 hour		
Roentgen diagnosis	2 hours		
Discussion—Quiz	1 hour		
Seminar	1 hour		
Daily		Daily	
Film interpretation	1 hour	Film interpretation	1 hour

The hours listed above should be essentially in the form of lecture demonstrations, group discussions and group examinations. The seminars should, if possible, occupy one hour per week, partly devoted to a presentation of original work by the residents or staff, partly to reviews of recent literature, society meetings, etc. At least one hour a week should be devoted to group discussion with the residents themselves and oral examinations. At least one hour daily should be devoted to film interpretation by the preceptor himself, ob-

served by the residents who should present their difficult cases for explanation and review. Such an hour should permit free questions and answers concerning the clinical material at hand.

A division of the time to be spent in practical work is presented below for consideration. Again it must be emphasized that this is tentative and must be adjusted to the needs of each institution. Furthermore, the rotation of residents will govern in a large part the arrangement of the schedule. The various clinical-radiological conferences which we conduct in our institution are shown in Table II. It is desirable

TABLE II

CONFERENCES

One hour weekly

Interdepartmental	
Pediatrics	Medicine
Surgery	Neurology
Orthopedics	Urology
Out-patient	Clinical-pathological
Surgical pathology	Postmortem pathology

Departmental

Roentgen diagnostic—Senior
Roentgen diagnostic—Junior

to hold as many such as are possible, in any teaching institution.

The conferences listed above are held between the clinical staff of the various departments and the radiological staff with as many of the radiological residents as possible attending. The films of the most interesting or instructive or difficult cases of the week are presented. These should be prepared by the resident assigned to the particular service, the clinical features and clinical discussion presented by the intern or resident on the clinical service. The clinical-pathological conference is well known to all and should be participated in by the radiological staff. Here, too, the films are prepared and presented by the resident, the discussion being carried on by the staff. A weekly conference with the department of pathology on the autopsies of the week, especially those in which roentgen examination has been made, is a very valuable exercise, in which as many of the residents as possible should participate. Another weekly conference is held with the surgical pathologist. Here all gross specimens removed at surgery and their microscopic appearance, as well as all biopsy material, are presented by the surgical pathologist. The roentgen findings in such cases are presented by a radiological resident with discussion by the radiological staff. This should be placed at such an hour that practically all the residents may be able to attend.

Two departmental conferences are held on diagnosis. At one of these the interesting cases of the week are presented by a resident and the staff is asked to make a diagnosis without prior knowledge of the case. Generally speaking, only cases proved either by surgery, biopsy or autopsy are presented. Some problem cases in which the final diagnosis is not yet established are also occasionally brought forth at this conference. At this conference there is opportunity for the roentgen staff to dilate upon the various features of the diagnostic problems involved. A second departmental conference is held in which only the residents and one of the members of the junior staff participate. Here cases not previously seen by some of the residents are presented by another resident. The residents themselves are called upon in turn to give an analysis of the case and present the diagnosis. We have purposely avoided having any of our senior staff attend this conference so that the residents will feel completely free to speculate and dilate upon these cases without the inhibitions which result from the presence of senior staff men.

In Table III is presented a tentative schedule of practical work divided into periods of three months. The order in which the departmental work should be assigned to the resident for his best development is shown but it is obvious that the rotation of the residents will not permit any strict adherence to this order.

It will be noted that we begin with technique and at the end of that period the resident is doing most of the bedside roentgenography himself. From that time on the resident is on call for emergency technique and has a regular assignment on various occasions during the month for this purpose. During the entire period of training, various conferences are assigned to various residents so that they may arrange the films for these conferences, study them, and be prepared to answer questions concerning particular problems of technique or diagnosis which might come up in their cases. I should like to call attention particularly to the last period of six months in which the resident is made the supervisor of the department. During this period he spends a good deal of time checking the roentgen requests, seeing the patients, determining whether the proper type of examination is being done. For three months of this time the resident spends practically all his time in what we call our "Wet Film Viewing Room." Here all films which are processed are seen by the supervisory resident while still completing the process of fixation, and he must decide at the moment whether the technique is sufficiently good to permit the patient to be discharged and as to whether a complete examination has been done. It is here that the resident must learn to determine what further studies need to be made in view of the findings which may be obtained in survey films, in simple films of the chest, or in the preliminary films of the gallbladder, urinary tract, etc. This is a most salutary and educational experience. Often the residents resent this time spent away from the preceptor and from other members of the staff, but, invariably, at the end of the time all residents realize that they have learned more from this experience than from almost any other exercise throughout their whole period in the department.

TABLE III

PRACTICAL WORK

Three Month Periods	Detail of Assigned Work
First	Roentgen technique—Bedside roentgenography
	Pediatric conference
Second	Assist roentgenoscopy
	Observe film interpretation
	Medicine conference
	Emergency call—Technique
Third	Roentgenoscopy thorax
	Beginning film interpretation
	Surgery conference
	Emergency call—Technique
Fourth	Roentgenoscopy abdomen
	General film interpretation
	Neurology conference
	Case presentations
	Emergency call—Technique—Diagnosis
Fifth	Roentgenoscopy abdomen
	Film interpretation
	Orthopedic conference
	Clinical-pathological conference
	Case presentations
	Emergency call
Sixth	Assist in staff viewing room
	Roentgenoscopy
	Film interpretation
	Urology conference
	Clinical-pathological conference
	Emergency call
Seventh	Supervisory resident for technique
	Check roentgen-ray requests
	Out-patient conference
	Revise library
Eighth	Check wet films
	Dismiss patients
	Surgical-pathological conference

It goes without saying that every roentgen diagnostic department should have readily available a well-indexed film library of extensive character with clinical information about each case, well summarized, in order to give opportunity to residents for collateral study. Further, there should be available a good library of textbooks and journals for study by the resident in his spare time. As was stated above, an abun-

dance of anatomical models, skeletons, and charts are imperative.

Some portion of every resident's time should be devoted to research or investigation. Regardless of how small or whether it is published or not, every resident should be given a problem or a case investigation and should devote at least one-fourth of his time to such study. A certain portion of each resident's time should be spent on special roentgen studies, such as angiocardiography, catheterization of the heart, cerebral angiography, encephalography, etc., when such procedures are being done in the institution. A reasonable amount of each resident's time should be devoted to experiments with new techniques, new roentgenographic procedures or in the development of new equipment. The desirability of a machine shop in connection with the roentgen department cannot be overemphasized. This is not always possible and not all residents will have a bent in this direction. But for those who do exhibit some aptitude toward the modification or development of equipment, some opportunity for the construction of new apparatus should be given. Some time should be spent revising and bringing up to date the departmental film library.

Recognition of the importance of medical ethics, the practical economics of radiological practice and of radiological organizations is highly desirable. Contact of the residents with other practicing radiologists in the community should be achieved in one manner or another. A few discussion hours on the economic and professional problems of medicine and especially of radiology are often very helpful. We permit our residents to help out the radiologists in our state by doing their work during vacation periods, thus giving the resident opportunity to observe the advantages and vicissitudes of the office and private hospital practice of radiology. Here, again, the example set by the staff is the most effective way to teach the ethics of radiological practice.

Finally, no such program as outlined here will be suitable for every institution. Variations in the general plan must be made to suit the character and needs of the particular teaching hospital. More important than any program is the ability and interest of the staff. Anyone who does not feel the impulse to teach should not conduct a residency program. Not only the impulse and the willingness to teach, but the ability to take the time for it must be present. The man who sits down to interpret films and is so harassed by work that he cannot be interrupted by his own residents with questions cannot do a good job of his residency. I suspect that nothing is more exhausting than having to discuss, answer questions, and elucidate about every case; yet this needs to be done if the preceptor is to do his duty by his residents. More important than any program is the willingness of the older, experienced preceptor to impart some of his hard won wisdom to the young man eager for knowledge. Above all, the aptitude and the attitude of the resident himself will have more influence in determining the quality of his training than any program which can be outlined.*

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* For discussion see page 456.

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RESIDENCY TRAINING IN CLINICAL THERAPEUTIC RADIOLOGY*

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IN THIS group discussion, I feel that I occupy a somewhat inter regnum position. My entire professional life has been devoted to the unrecognized specialty of Clinical Cancer Therapy. As such, I hope I may be able to qualify as something of a Therapeutic Radiologist; but I also feel that my sphere, if any, may extend a bit beyond that field. That is a point to which I shall refer later but which I shall not stress.

As I see it, we have today and probably will have for at least another half of a professional generation, the two-fold responsibility of training in Therapy to meet the immediate needs of the average community and, at the same time, training and planning into the future to meet the immediate needs of our larger communities of today and all communities of tomorrow. In other words, we must provide training for two types of Therapists: General Practitioners and Special Practitioners of Therapeutic Radiology.

Without going into a detailed discussion, and certainly with no intent to introduce the point for debate at this inappropriate time, I believe it is a fair statement that majority opinion today would support the views that both Diagnostic Roentgenology and Therapeutic Radiology would be better done and more rapidly advanced if the two fields of endeavor were completely separated. That statement is more particularly true with reference to Therapy because, in General-Radiology, it has always occupied a decidedly secondary position.

However, it is not always possible to follow an ideal course or plan under any and all circumstances. The shift to division of the two fields of Radiology is coming about slowly, and all too often grudgingly, in our larger institutions but it is obvious that such a plan will not be possible in the rank and file of our hospitals across the country for many years.

Hence, we must plan for general training in Therapy to be integrated with diagnostic work and we must plan for the best that can be provided, in detail, for those whose interest will be in Therapy alone.

Before taking up a number of the debatable points that must be considered under these plans for the improvement of our Therapy Training, there are two or three requisites that I believe warrant special mention. The greatest single need today in our Departments of Therapeutic Radiology is the Radiation Physicist working in first-hand cooperation with the Clinician. I believe it is not an overstatement to say, with certain reservations, that a full-time Radiation Physicist should be obligatory for "full residency training" approval in hospitals. The "reservations" I referred to are few: Certain of the smaller or medium-sized hospitals have met the situation, as far as their circumstances will permit at present, by group support of a Physicist. A few medical heads of departments have done a very commendable job of doing their own physics teaching—these gentlemen deserve great praise. One in particular deserves more than praise. Regularly his candidates in Therapy, appearing before the American Board of Radiology, are in the top flight. From this it might be argued that the younger men are being turned out with a much better physics training and background than their predecessors and, therefore, why shouldn't they handle their own physics teaching? The answer is simple: They haven't the time. Their strictly clinical responsibilities do

* Presented in a Symposium on The Training of Residents in Radiology at the Fifty-first Annual Meeting, American Roentgen Ray Society, St. Louis, Mo., Sept. 26–29, 1950.

not leave the amount of time needed for physics assistance to the residents in training. The physicist must work *with* these trainees—not just as a cloistered consultant.

Another major correction that is badly needed, in my judgment, lies in some of our terminology that is apt, in turn, to dominate our thinking in a prejudicial manner. We give too much thought to Therapeutic Radiology in terms of Roentgen Therapy or radium therapy and little or no consideration, perhaps, to some of the newer sources of radioactive energy. Why not think and speak in terms of ionizing radiations and let the source be of secondary importance—to be considered only in selecting the most efficient source for the particular occasion.

That brings us to another important point. The American Board of Radiology began with several groupings acceptable for certification. These have been reduced but I believe that further reduction should be made. Certification in Roentgen Therapy alone is no longer granted and the same is true for Radium Therapy. But, certification in Roentgenology continues to be recognized. What this really means is certification in Diagnostic Roentgenology plus the questionable privilege of selling Roentgen Therapy by the dose. Such practice in Therapy discredits Therapeutic Radiology.

Residents in Therapeutic Radiology should be trained in the full range of Therapy by means of ionizing radiations, whether the source be roentgen rays; alpha, beta, or gamma rays from radium; or the radiations from radioactive isotopes. The American Board of Radiology should encourage this by adhering to three groupings: Radiology (the entire field), Diagnostic Radiology, and Therapeutic Radiology.

Training of Residents in either Therapy or Diagnosis is influenced largely by Board requirements. To begin with, the period of training and the requirements preliminary to the specific training period were decided upon after much deliberation but, nevertheless, arbitrarily. It would seem fair, therefore, to inquire into whether these requirements are still considered satisfactory.

From the standpoint of the man headed for general radiologic practice, I think the three year period is acceptable for Therapy providing he gets *half* of that three year period in Therapy training. I am not so sure that the one year of rotating internship, preliminary to the three year residency, is adequate under any circumstances.

On the other hand, for the man who plans to go into Therapy entirely, it is the opinion of many careful students of the problem that at least four years, instead of three, should be devoted to the Residency. On the matter of time allocation of this four years, however, there is no unanimity of opinion. Probably the nearest to common accord is on the point of one year of the four to be devoted to Diagnostic Roentgenology. This is on the basis of providing a better working knowledge, both of conditions to be treated, and methods of using diagnostic techniques for purposes of therapy localization.

Beyond that, all sorts of combinations have been suggested—all aimed at adding more training in one or another of suggested ancillary subjects. These range from surgical techniques and pathology to physics and radioactive isotopes. Individually, all of these suggestions are laudable, even though the composite pattern created becomes hopelessly miscellaneous.

Additional study in any allied subject is of value in training for any specialty providing it has a real objective and is planned in an orderly manner. I have no formulated plan or solution but, for purposes of stimulating thought, I would like to offer certain observations.

We are now in the anomalous position of granting certification in Therapeutic Radiology through the American Board of Radiology after a one year rotating internship plus a fraction—usually much less than half—of a three year general radiology residency. At the same time, we demand full three years' training with the same background and the same basic science

study for the same certification when the candidate is interested only in Therapy. Added to that, we are suggesting still higher training requirements for Therapy only—and I think rightly so.

The unfairness of the two types of therapy certification, however, is so obvious that it becomes ludicrous. I do not have a solution to offer for proper recognition of the more completely trained Resident in Therapeutic Radiology only. Obviously his examination should be more comprehensive; if he comes from training at a university teaching center, it would be possible to have indirect recognition through the medium of a university post-graduate degree, such as "Master of Science in Therapeutic Radiology," conferred by the university—following his certification by the American Board of Radiology. Since the Board does not have university status it could not recognize the more complete training by granting a degree; some distinctive unification will be needed at the national, rather than state or local university, level.

Let us return briefly to a further consideration of the pre-residency internship requirement. One year serves scarcely more than an orientation period. During that interval, following World War II, when post-graduate medical training was so difficult to obtain by many men just returning from the Service, a very careful survey and report was made by a subcommittee of the New York Committee on the Study of Hospital Internships and Residencies. It showed very conclusively the much enhanced value of a two year internship in which the first year followed the rotating pattern while the second year became either all medical or all surgical, depending on what branch of practice the candidate preferred. It seems to me that such a plan would provide a much better background for the Resident in Radiology—and that the resident most interested in Therapy would obviously be better fitted by having had the second year of a two-year internship in Surgery.

Referring further to the suggested allocation of one year, of a proposed four year Therapy Residency, to Diagnostic Roentgenology, I must say that I can appreciate the spirit of loyalty back of it, but fail to follow the rationale. A working knowledge of Diagnostic Roentgenology is essential to the Therapist, but no more than it is to the internist or surgeon. It is my humble but very firm conviction that if a Therapy Residency Training Program has a year unplanned for, it had best be spent in surgery, especially in acquiring just as much as possible of facility in surgical techniques.

Another major requisite for the Therapy Resident that is not being filled at present is basic training in the natural history, vagaries and clinical course of the more common groups of malignant or neoplastic diseases coming under the unfortunate general heading of Cancer. Indeed, as one attempts to foresee or philosophize on the probable trend in Therapeutic Radiology in the future, it becomes a nice question for conjecture as to whether it will be dominated from the radiologic or the cancer viewpoint.

Returning to the more practical problems of what we are going to do *today* to improve Therapy training, let us consider one of the very rigid requisites of the American Board of Radiology—namely, supervised training and instruction. No one could question the wisdom of this or, conversely, the iniquity of unsupervised "work" which may provide a modicum of empiric experience but no training. The question is: How rigid should the timetable be? It is my opinion that the impersonal physician-patient relationship and fast moving schedule of the Diagnostic side cannot be applied in the same manner in Therapy. The Art, as well as the Practice, of medicine must be respected for best results in Therapy and this should never be lost sight of in the training of residents.

The trainees should always be given ample time for discussion and help with their problems. They should be encouraged to look up references immediately on any

point of importance that has been under discussion. It is rather appalling at times to find in American Board of Radiology candidates the ignorance of standard reference textbooks or of current literature. If these are not provided by the department and their use encouraged, the candidate is not wholly to blame.

Some months ago I asked one of our very best teachers of Therapeutic Radiology, judged by the consistent showing of his trainees in Board examinations, for an outline of his training program. He rather apologetically admitted that it did not follow a very exact curriculum. However, as our discussion continued, it soon became evident that he and his Senior Staff spent a very great deal of time in personal, group and individual, discussion and instruction with their residents. His final apology for turning out good, well trained men was that "We are interested in our men and like to see them get along well." The human personal touch pays handsomely.

In addition to the daily clinical routine, it is obvious that a full and complete range of therapy material and problems will rarely be encountered within the period of any one residency. Even then it will not be in orderly sequence. Hence, a course of semiformal clinical lectures to cover in a systematic manner the complete general field of therapy should be planned as a part of the training program. It should be lively and stimulating and neither too long nor too frequent to be boring.

If planned for the late afternoon or early morning, on a weekly or fortnightly basis, it might well serve as an added attraction and benefit for a number of nearby institutions. Such plans, in principle, are already doing yeoman service in both clinical training and in radiation physics. The trouble is that the practice is not sufficiently widespread.

The requirement of six months of pathology, with the inference that it should, by preference, be spent as a full time straight six months, is, I believe, open to some question. It is axiomatic that as much of pathology as possible is not too much for the specialist in any branch of medicine. With demands by all of the qualifying Boards for periods of training in pathology, it is indeed a matter of wonder that the pathologist stands up under it as well as he does. It is not possible for him to integrate all of the specialty programs, as their representatives would like, especially to the extent of full time periods for all. Apart from the fact that laboratory methods can be understood only by full time association, I think a close pathology department contact carried on throughout the entire residency training period offers far more in the end than the shorter interval of laboratory stuffing.

At a recent session of the Examining Board, I was much impressed by a simple routine procedure that apparently had proved to be most effective. The therapy residents met regularly each morning at a fixed period, for one hour, with the pathologist and during that interval all of the tissue sections for the previous twenty-four hour period were studied together. The institution was not a large one, yet, of the three best candidates that it was my privilege to examine at the Board session, two of them were from that hospital. It is my further opinion that the type of pathology training should, as far as possible, be varied between the Diagnostic Roentgenology resident and the Therapy resident. The former will profit more from general surgical pathology and the latter from gross and histopathologic tumor pathology.

Carrying the same idea over into the training in physics, I would offer for consideration the suggestion that after the basic physics of radiation is covered, the pattern of emphasis might well, for Therapy, move toward the relationship between physics and biology and on to a general study of nuclear physics and radioactive isotopes.

I feel very strongly that Therapeutic Radiology is today neglecting a responsi-

bility toward the isotope problem—probably because too many department heads are too busy to adequately familiarize themselves with the rapidly accumulating information and complexity of these newer sources of ionizing radiations. Whatever their level in medicine in general, and Therapy in particular, may ultimately come to be, the fact remains that they are sources of ionizing radiations, that they are being constantly added to, that they have some measure of value in both diagnosis and therapy and that they are also dangerous. To say the least, they should be managed and controlled by and through a department already familiar with the hazards of ionizing radiations.

It cannot be too often repeated that training in Therapy should and must cover all forms and sources of ionizing radiations. The tremendous advance of roentgen therapy over the last twenty-five years has encouraged too many radiologists to withdraw to the semi-cloistered seclusion, and safety, of the roentgen department. They are ignoring the limited but very real contribution of intracavitary and interstitial irradiation from radium and radon for certain special problems that, so far, have not been successfully met by roentgen therapy alone. Many are not even aware of the possibilities attendant upon radium as a source of external irradiation of the very highest quality. At the same time they are ignoring the challenge of, as well as the responsibility for, the radioactive isotopes. Such "radiologists" should be excluded from the Therapy residency training programs; indeed, they should not be offended if their titles revert to that of "X-ray Men." Scientific accuracy can only be approached by recognition and integrated study of all sources of ionizing radiations.

Accuracy and meticulous attention to detail is one of the greatest needs in Therapy training at the present time. We badly need to think constantly in terms of that attention to detail that is a part of the daily code of the successful surgeon. I have thought at times that greater attention to detail and accuracy might well be stimulated in some of our largest institutions by dividing the Therapy into two services. The same principle is an excellent stimulus to greater endeavor in medical and surgical wards.

Since I have referred to the use of radium as an indispensable aid in certain cases, may I offer a suggestion whereby residents might be enabled to get more experience. The use of this source of energy is often neglected because of interdepartmental bickerings and jurisdictional disputes. The narrow mindedness cannot be all on one side. Conciliation and cooperation would give both the radiologist, his assistant staff, and the members of the other specialty services, advantages that could not be obtained if one or the other were excluded.

I find, as I look over my notes, that there are many isolated features I have not touched upon.

Mention, with commendation, should be made of integrated training plans in groups of smaller hospitals to the end that a full, well rounded, complete Residency Training can thus be worked out cooperatively. On the contrary, I can see no value in a one year residency-approved position for the Therapy trainee. It is true that he can, perhaps, get three such jobs—adding up thus to three years. The net result is three times "not much."

Preceptorship training for Therapy may have some very limited application but it can only be evaluated on a strictly individual basis.

In closing, may I stress especially a few points that I regard as being of outstanding importance in Residency Training in Therapeutic Radiology.

The demand for well trained therapists is greater than the supply. Hence, the greatest of care should be taken in selection of candidates for the all too limited training facilities. The specially trained Radiation Physicist is an essential member, not as consultant, but as active participant, in Clinical Therapy and, hence, in Residency Training.

There is urgent need for more training and instruction in the clinical phases of cancer to the end that the resident in Therapeutic Radiology may have a clearer visualization of the extent and rationale of the therapy problems.

Finally, the Therapeutic Radiologist, by virtue of the very serious character of his work, must measure up to the best traditions of medicine. It is not enough that he be a highly trained super-technician. The type of patient with whom he deals is in need of the best in general and supportive medical care as well as expert specific therapy. In addition to all else, the Radiation Therapist or Cancer Clinician must never lose sight of the fact that the honest Art of medicine is as essential as the Practice in meeting many of his problems successfully.*

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* For discussion see page 456.

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THE TEACHING OF RADIOLOGICAL PHYSICS AS A PART OF TRAINING IN RADIOLOGY*

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THE radiologist is fundamentally a doctor; any instruction in physics during his training period is to be directed toward improving his clinical efficiency, not toward turning him into a part-time physicist. The aim is to provide him with a clear understanding of his tools and how they behave, their possibilities and limitations, and how he himself can get the most from them. The needs for the diagnostic and the therapeutic radiologist, fundamentally the same, may require somewhat different emphasis. However, since the majority of students in radiology in the United States now prepare themselves in the entire field, even though they later specialize in one part of it, all can use essentially the same physical training. The American Board of Radiology, by having physicists as guest examiners, has indicated its appreciation of the importance of this basic field.

Physics teaching should be by way of lectures, informal discussion and quiz periods, laboratory experiments, practical problems and assigned or suggested reading. These divisions should be considered both as to method and content. Obviously neither a textbook nor a formal lecture course alone can be satisfactory, although either or both have definite value. As to formal lectures, few hospitals have on their staffs full-time radiation physicists with teaching inclinations. However, those institutions in which courses are available usually open them to interested individuals within the city or the neighborhood. In other cases a visiting physicist can give a short and intensive course for a group. The refresher courses of the two radiological societies are also helpful. By these means the student radiologist may have the fundamental ideas presented to him, but they do not become a part of his permanent equipment unless he takes effort to make them so. The physicist in the institution will supplement his lectures by various types of informal meetings, demonstrations, and practical problems. If there is no physicist available the radiologist must take the responsibility of supervising these activities. Even when there is a physicist, he and the radiologist will find active collaboration the most satisfactory procedure. The radiologist should not expect the physicist to decide what the students need and see that they get it. Worse still, he should not feel that just because there is a physicist on the staff, satisfactory instruction will be forthcoming. The physicist may be more interested in other things than teaching, or he may feel that if the students want to know anything they will come and ask him. This is seldom the case; he must not only be available, he must be ready to take the initiative.

The radiologist and the physicist must collaborate in training in clinical dosimetry, and joint planning of other parts of the program will be rewarding. Many departments have frequent film-reading and radiological-pathological sessions planned for their residents. Similar therapeutic-physical sessions dealing with current treatment problems are valuable, as are also meetings of the journal-club type. Care must be taken not to have so many meetings as to make it onerous, but a half-hour at noon-time once a week for case presentations or special problems, another weekly hour late in the afternoon for discussions (at which the physicist may be the "quiz-

* Presented in a Symposium on The Training of Residents in Radiology at the Fifty-first Annual Meeting, American Roentgen Ray Society, St. Louis, Mo., Sept. 26–29, 1950.

zee" more often than the quizzor), a journal-club meeting one evening a month, devoted sometimes to physics and sometimes to therapy, in addition to possibly 25 formal lectures during a part of the year, and continuous practical dosage work in the therapy department, have in our experience been a satisfactory arrangement. In all of these except the lectures (and occasionally in them) there is complete radiologist-physicist collaboration. A valuable part of this sort of training is the stabilization of the radiologist-physicist relationship for the student. He learns what he should and should not expect from a physicist, when and if he has his own department. This relationship as it is developing in the United States is rather different from that generally found in England. Our physicists are likely to have other interests besides the radiotherapy department, and (unfortunately) do not usually have a group of trainees in physics to whom much of the arithmetical work, the making of moulds and positioning devices, and laboratory supervision can be delegated. The result is that the student radiologist must learn these things by actually doing them—which, I believe, is better for him.

To consider in more detail the content of the physics teaching, the broad general survey will probably consist of lectures or readings on basic electric and magnetic concepts, general ideas of tubes and circuits, the production of radiations and their interaction with matter, detailed considerations of dosimetry and of protection. Enough attention should be paid to basic mathematics so that simple calculations and curve-plotting are readily and surely done. Basic statistical considerations should be presented so that the student will have knowledge of the significance of collected results, in order that on the one hand absurd conclusions will be avoided, and on the other, no legitimate information will be overlooked. The proper keeping of records, while primarily considered a clinical duty, needs consideration from the point of view of what basic physical and dosage data should be recorded, and the best manner in which to do this to insure future usefulness of the charts.

The time which can be devoted to formal laboratory experiments may be brief, and in any case it is not certain that set experiments are the best form of teaching at this stage. On the other hand the proper use of standard measuring equipment should be learned by carrying out such procedures as calibrations and the determining of half-value layers, under actual departmental conditions. A phantom should be available, and everyone should make some depth and exit dose measurements with it, and at least assist in the construction of an isodose chart—even though in actual practice he will probably employ charts and tables more carefully prepared in the laboratory. Some part of a protection survey should be made, in order to achieve familiarity with survey methods and instruments. This may well be done in a therapy room with a patient undergoing treatment. It is instructive to prepare a calibrated set of exposed films, to have an idea of just what exposures are indicated by observed densities, and incidentally to demonstrate how much more complete protection is needed for film storage than for personnel.

If radioactive isotopes are being employed in the institution, either for tracers or for therapy, a little time should be spent in the isotope laboratory, learning the fundamentals of use of Geiger counters for standardization of radioactive solutions and of their employment in clinical work. This should be a scheduled program, not merely casual visits.

In the course of actual therapy, various possible treatment plans should be worked out in detail, not as an exercise on a routine case that can be hurried through, but as a part of preferred clinical procedure, for patients of special interest, where the treatment will finally be decided upon the basis of the analysis. Such cases may not be common, but there will be enough of them if they are looked for. The responsibility for such a problem often stimulates further

study. If the planned treatment involves the use of moulds or positioning devices for careful beam direction, and these need to be specially made, the student should at least assist with their construction. The preparation of a partial three-dimensional isodose chart for the critical region being treated often affords a vivid picture of the situation. This can be made on sheets of transparent plastic, interlocked after the isodose curves in the three principal planes of reference have been drawn on them. Similarly, with radium, the actual reconstruction of complete implants from the radiographs, although tedious, is a valuable experience.

Some discussion is in order of the advantages which may be expected from better training in radiologic physics. The aim in radiation therapy is to deliver enough radiation to the tissues in question so that the desired effect may be produced in the diseased region while the normal tissues and the patient as a whole do not suffer unduly. Radiation therapy has progressed from the stage of "Give this tumor a good dose of radiation but don't redden the skin," through "Treat these standard fields to the limit of skin tolerance and hope for the best" to "Let us consider this particular case (or type of case) and see what combination of factors should be the best." This involves a thorough knowledge of both the possibilities and the limitations of the various modalities, and how they may best be combined. It should cover not only conventional and available equipment, but should include some knowledge of what may be expected from various new developments.

No one believes that the radiologic treatment of cancer is just a branch of applied mathematics or a problem in solid geometry. It has been said that since cancer is not a disease of regular geometrical masses and of treatment by actual point, line, or plane sources, the physical calculations are ridiculously inadequate. We know from experience that they are often inadequate, but never ridiculously so unless either the approach or the interpretation is ridiculous. Thinking of the tumor dose rather than the skin dose, for example, focuses the therapist's attention on the tissues which are to be affected, and avoids errors of judgment, such as inferior positioning of fields, lack of attention to the actual size of the patient, or downright neglect of the consequences of backscatter, inverse square law, and penetrating power of the chosen radiation.

It is sometimes suggested, usually by radiologists who have not yet become conversant with the advantages of the physical rather than the empirical approach to therapy, that all this extra calculation does not really accomplish much. It is stated that the radiologist has too many other duties to spend so much time working up a single case, that it is all very well if there is a physicist to whom these problems can be turned over, but that it is not practicable in the general busy department. There are several points here which merit attention. First as to the time consumed; from the point of view of the patient, this is hardly an acceptable argument. Many cases fall readily into classes which have been thoroughly analyzed; with very little special work-up they can be treated by a plan which has been found good. But the less ordinary ones, not easily classified, in which success or failure may be determined by adequate irradiation, and which present unusual features, surely merit every consideration.

As for needing a physicist to do such an analysis, it is quite true that he can help, but it is the radiologist who must decide on the dose and establish clinical and anatomical features. Dosage planning should not be the responsibility of the physicist. It is something the residents and fellows can and should undertake with aid and supervision from the radiologist and from the physicist if one is available. An intelligent technician to help with the arithmetical calculations will be found an invaluable assistant, but she cannot take responsibility for planning treatment.

And finally, as to the statement that all this extra calculation does not really accomplish much, certain things may be said.

The increase in percentage of five or ten year cures is something which cannot quickly be demonstrated. Most radiologists who have paid attention to the new techniques of dosimetry and careful positioning feel that the immediate and palliative results have improved. We can never lose sight of the fact that once the lesion ceases to be localized, no amount of precise dosimetry will solve the problem; this is also true if the original localization is inadequate. It has been stated also that no amount of physical calculation will solve the puzzling question of radiosensitivity, but this may not be completely true. It is not doubted that certain types of cancer are more radioresistant than others; physical dosimetry has no connection with this. However, it has been said that a certain type of cancer is more radioresistant in certain locations than in others, and on investigation one frequently finds that the "radioresistant" locations are those in which it is more difficult to be sure that an adequate dose is being delivered. Is this radioresistance or poor dosimetry? In some instances, where careful planning, with addition of previously unused fields, has made possible the delivery of an adequate dose, preliminary results indicate that the supposed radioresistance is not so marked.

Radiologic physics is not a blanket substitute for any of the clinical aspects of radiation therapy; it is a supplement. It can be a very powerful supplement, and the young radiologst has the right, and the duty, to know just what he can expect from it.

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DISCUSSION OF SYMPOSIUM ON "THE TRAINING OF RESIDENTS IN RADIOLOGY"; PAPERS BY DRS. KIRKLIN, RIGLER, QUICK, AND QUIMBY

DR. MERRILL C. SOSMAN, Boston, Mass. I am supposed to confine my remarks to the papers dealing with diagnosis, but I just can't pass up the chance to get into this little fight about the separation of diagnosis and therapy.

Having spent two months abroad this year, I saw the separation working beautifully in Norway, Sweden and Denmark, where they have homogeneous and law-abiding populations. A little different situation was present in England, where it also was divided into two completely separate specialties in the larger centers.

There, Dr. Quick, I think you will agree that the radiotherapist is not the stepchild of radiology, but has taken control. The radiotherapist in England really is running the show, and he has elevated the physicist to a much higher spot than he deserves. He has too much responsibility. He has the aura of infallibility about him which I think you, Dr. Quick, would be the first to decry.

With a great deal to be said on separation, it is not my job to do that today. I certainly agree with Dr. Kirklin that it cannot be legislated; it has to grow and develop, and I am sure that it will grow and develop and separate in the United States in time to come. That may be speeded if the federal government takes over medicine and hospitals and medical schools, as I also feel will inevitably occur. But that is still another problem.

Getting back to my assignment of diagnosis and training in diagnosis, there are a great many institutions throughout the country, and a great many varieties of programs, and each has its good points and each its faults. I think the basic concept in all of them can be brought down to two:

First, that each trainee should have responsibility for certain examinations, under supervision at first, of course, and later on his own, but checked in the serious cases by his teacher. That responsibility is not just for the technical examination and the reporting, but for the consideration of the patient as a whole and correlating his radiological findings with all other knowledge concerning the patient.

I am always delighted when one of my residents brings a problem to me and says, "Dr. Sosman, this hard-working Italian bartender does so-and-so." He knows he is hard-working and conscientious, and that he is Italian, and that he is a bartender. Those are three very important basic facts, at least in the medical practice in Boston. I am glad he says it in those words instead of saying, "This case has so-and-so." He looks at the patient, not just the x-ray

film. That is point No. 1: He must have responsibility for the patient's welfare.

Secondly, I feel that he must have the stimulus or the guidance, or whatever you want to call it from above. I don't mean scolding; I don't mean fault-finding—I mean a genuine interest by a person who has earned the respect of the trainee, so that he can guide him in similar examinations later.

In the final analysis of training in roentgen diagnosis, I believe that the course of instruction is not as important as is the opportunity to learn. He must have a variety of material. He must have many clinical conferences or the opportunity to attend such conferences, as Dr. Rigler pointed out. The rest is up to the trainee himself.

Most important of all, in my humble opinion, is not the institution, not the teacher, but the selection of the candidate himself. I have seen some of the best men come from poor institutions, and I have seen some terrible failures come from the best training institutions. Improper selection is the answer. If the candidate has a desire for knowledge, if he has the will to learn (which is the thing I always search for), and the ability to acquire knowledge from his environment, he will be a success disregarding his environment and the formal program.

I shall not take the time to outline our own individual system of teaching. I would say one thing, however: I believe that pathology should come after the trainees have had some radiology. Having had at least six months of radiology, he gets the radiological viewpoint and he knows what he wants to know. It is much more valuable to have six months of pathology after a certain amount of radiology than a year of pathology before no radiology at all.

We like, when possible, to alternate our men with different backgrounds. If one man has had a surgical internship (and most of our men, Dr. Quick, have had at least two years since graduation, and some three, four and five, particularly the Army group), if we have one man with a good surgical background, we like to pick the next man with a good medical background, or a man, shall we say, with training in research in physiology, so that each man will bring some special training and knowledge to contribute to the group as a whole. It is surprising to me how much these trainees educate each other. We take the credit for it, and actually the boys do a lot of the work themselves.

I think I can say without boasting that in many university hospitals at the present time the radiological residents are among the best in the institution. Going back still further, I think the important thing is to get the right kind of men interested in going into radiology. That must be done on the medical school level. If the department of radiology does not have adequate opportunity to teach and stimulate the students, they will not have a good choice of candidates from which to select their residents.

Dr. H. Dabney Kerr, Iowa City, Iowa. It is a pleasure to be able to discuss papers such as Dr. Kirklin, Dr. Rigler, Dr. Quick and Dr. Quimby have presented to us.

There is nothing to add to what Dr. Quimby has said, but I think it is important for us to remember that many of us in the country, out in the byways, do not have the opportunity of having a physicist in our department. Nevertheless, we are greatly indebted to the physicists for what they have done—not only in the instructional courses at such meetings as this, but in the preparation of texts, in their articles and in their personal conversations—to make us aware of the value and the necessity of basic training in radiation physics.

I think this is perhaps of a little more importance to the therapeutic than to the diagnostic side of radiology, although I will not question what Dr. Rigler or Dr. Quimby has said regarding the value of radiation physics to the roentgen diagnostician.

For those of us, therefore, who do not have the opportunity of joining forces in getting instruction direct from physicists, it is all the more incumbent upon us to use what information is available, and to see to it that we try to integrate this information with the clinical problems—the physical clinical problems—that come before us every day in the outlining of therapeutic measures in our individual cases.

That is the thing which we have to do—and we can do that only if we have a basic interest in the teaching of this subject in conjunction with our own clinical problems. If we do not have this interest we can never guide nor direct our men into their proper course of training.

Dr. Quick has talked ably about the training of the radiation therapist. I agree with him heartily that it is incumbent upon those who say that they are trained radiation therapists to include radiation therapy, and not to confine

their instruction nor their stimulus merely to the roentgen aspects of the problem.

The radiologists at one time had almost lost radium therapy, and it was because they evinced no interest in the subject. The reason for this is because the gynecologist, the surgeon, the dermatologist and the otolaryngologist had an interest in the use of radium, and many of us said, "Well, what of it? Let them do it. We aren't interested."

That is true; and many say, "Who cares?" That is just the point: If we as radiologists are going to allow radium therapy to go by default, we are also going to allow isotope therapy to go by default. If that is the wish of men who are training in therapy, it is my humble opinion that they should not attempt to train therapeutic radiologists.

To concede that roentgen therapy alone encompasses radiation therapy, to my mind is a great mistake. As Dr. Quick has so ably pointed out, radiation therapy covers not only roentgen therapy but all of the modalities which give us ionizing radiation. I think we must be very careful not to put ourselves into the position of "selling x-ray treatment by the dose." If we do that, we will have done far more to discredit radiation therapy than we have done to enhance its value.

Finally, while I agree with Dr. Sosman regarding the selection of trainees, the next most important thing is what he and Dr. Rigler have said—that if you do not have an active interest in teaching the men whom you take on for training, you had better not train them nor attempt to train them. You must have this active interest in teaching, and be willing to give the time, the thought, the energy which they must have—not only the direction, but your own time and your own experience.

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DEPARTMENT OF TECHNIQUE

ROENTGENOGRAPHIC STUDY OF THE HIP JOINT IN THE LATERAL PROJECTION

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THE hip joint is commonly subjected to injury and disease, sometimes resulting in permanent disability that might have been avoided if a correct diagnosis had been made. It is one of the few parts of the body that is almost routinely studied roentgenographically in only the anteroposterior projection. Minor injuries resulting in posterior lip fracture or infractions are frequently overlooked or are not apparent in this customary projection, in either plain or stereoscopic film studies. Likewise fractures that practically always complicate posterior femoral dislocations are seldom seen except when large and when there is gross displacement; even then the position of the posterior fragment cannot be accurately determined. As in fractures, early evidence of disease may be entirely obscured by normal bone of the acetabulum and femoral head in the anteroposterior projection.

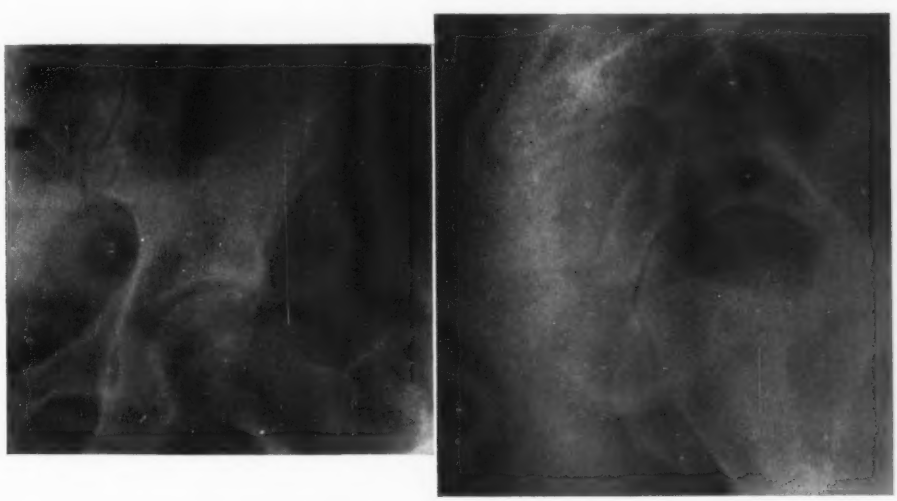

FIG. 1. CASE 1. Lateral projection demonstrates a fracture of the posterior lip of the acetabulum with upward displacement of the fragment.

Many positions have been presented for obtaining lateral views of the hip joint. The one commonly used by the writer has been quite satisfactory.

The patient is placed on the side, the pelvis is tilted forward (anteriorly) 20 degrees to avoid superimposition of the opposite (off table) hip. The tube is angled cephalad 10 degrees to allow projection of the hip joint through the opposite (off

table) sacrosciatic notch, central ray directed through the acetabulum. This lateral view is used in conjunction with, but not as a substitute for, the regular anteroposterior projection. The following cases illustrate the necessity of this position as an integral part of a roentgenographic examination of the hip joint.

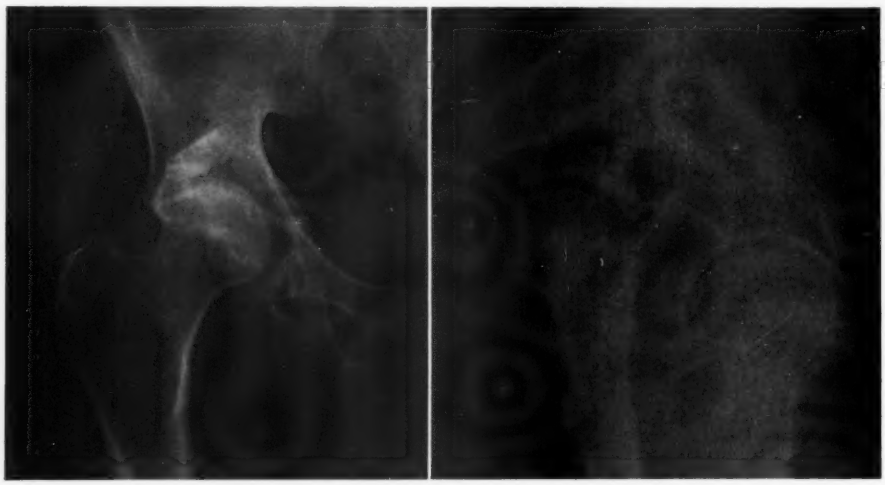

FIG. 2. CASE II. Fracture of the acetabulum. The posterior half is rotated upward 90% and is fused in this position. In the anteroposterior projection fracture is easily recognized, but the position of the fragment of the acetabulum could not be determined.

CASE I (Fig. 1). Injured one week prior to the examination in an automobile accident. Posterior dislocation was diagnosed and reduced, but the film in the anteroposterior projection furnished no hint of the type of fracture of the posterior lip of the acetabulum nor of the amount of displacement of the fragment. When a lateral view was obtained, prompt operation, reduction and fixation of the fragment resulted in complete restoration of function.

CASE II (Fig. 2). Severe injury in automobile accident. Posterior dislocation was recognized by clinical examination and reduced. Stereoscopic anteroposterior views revealed a fracture of the acetabulum, but the extent of fracture or displacement of the fragment could not be recognized. Later a lateral view revealed the fragment of the acetabulum fused in a position of 90° posterior rotation, and the femoral head articulating with the segment of joint surface of this posterior fragment. Open reduction was attempted, but ankylosis was finally necessary.

SUMMARY

Lateral as well as anteroposterior views are an essential part of all roentgenographic examinations of the hip joint, particularly following injury. The customary anteroposterior views are inadequate for the roentgen study of either disease or injury of this articulation. A technique for the taking of lateral roentgenograms is presented.

450 Sutter St.
San Francisco, Calif.

AN IMPROVED COMPRESSION BAND

By I. KLEIN, M.D.
NEW YORK, NEW YORK

THE present compression band which we have for immobilization of various parts of the body is cumbersome. Quite often it is not used; the roentgenograms taken without it are not satisfactory. Therefore, we have devised a compression belt which can be more simply applied.

The belt, which we present, is made of elastic webbing with a handle and hooks on one side and a clip which can be adjusted to size by fastening it into any of the three tucks or into the hem.

We have found this belt more easily applied and adjustable than the usual compression band.

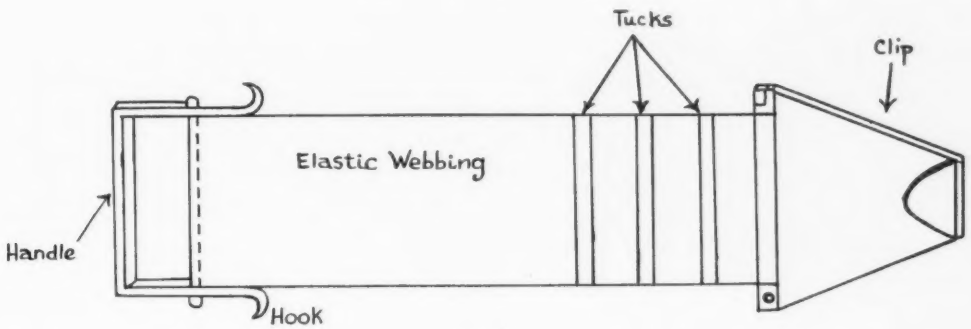

FIG. 1

This belt was made by the Picker X-ray Company and I wish to thank them for their cooperation and assistance in helping work out this appliance.

100 Central Park South
New York 19, N. Y.

FIG. 2

FIG. 3

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

Editor: LAWRENCE REYNOLDS, M.D. *Assistant Editor:* RUTH BIGELOW, B.S.

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Thirty-fourth Annual Meeting: Stevens Hotel, Chicago, Ill., June 8, 9 and 10, 1952.

EDITORIALS

VITAMIN-RESISTANT RICKETS

A NEW DEFICIENCY DISEASE AND A COMMON CAUSE OF DWARFISM

FOR many years it has been known that some cases of infantile rickets did not respond to treatment with the usual doses of vitamin D but did respond to larger doses. In 1937 Albright described a severe and vitamin-resistant type of rickets to which he applied the name of vitamin-resistant rickets. These children were characterized by the usual physical and roentgenographic findings of florid rickets plus a short stature. Above all, they failed to respond to the usual treatment of rickets but did respond to massive doses of vitamin D in the range of 100,000 to 1,500,000 units daily. The metabolic studies in Albright's one case showed a decrease in inorganic phosphorus, a normal or low serum calcium, an increased serum alkaline phosphatase as well as a decreased urinary calcium and an increased calcium and phosphorus in the fecal content. Pedersen and McCarroll,[1] in an excellent study of this disorder, examined a series of twenty-five children and nine of the ten parents who were afflicted by this disorder. They feel that this disorder is far more common than has been previously recognized, that it is the most common cause of dwarfism, and that it has a strong familial tendency. Investigators working on this problem have established that vitamin D is not absorbed at the usual dosage, and that it may be present in the blood stream at concentrations in excess of the normal, but still not show evidence of chemical or roentgenographic healing.

The physical appearance of this group of patients is a most striking and important characteristic and should at once suggest to the observer the possibility that he might be dealing with this condition. All their patients had the usual signs of active rickets such as enlargement of all of the palpable epiphyses, Harrison's groove, rachitic rosary, and frontal bossing. In addition, they were of a short stature resulting primarily from a lack of growth. This was especially obvious in adults. Of the ten adults examined by Pedersen and McCarroll, the tallest was 5 feet 3/4 inches with most of them less than 5 feet. The lower extremities exhibited marked deformities such as bow legs, knock knees or the "tackle deformity" in which one leg is bowed and the other knock kneed. In several, the femora and tibiae also underwent severe anterior bowing. These investigators further point out that it is characteristic of these deformities to recur after early correction by osteotomy. In each of these children the extreme and persistent deformities of the bones in the legs had necessitated one or more osteotomies. In the group of twenty-five children 122 osteotomies had been performed twenty-five of which were for recurrences. Associated with the severe deformities of the lower extremities is a ligamentous instability about the joints, particularly the knee, which causes moderate pain on exertion. These individuals also exhibit a characteristic waddling gait due to the marked coxa vara. The skull, in addition to the usual frontal bossing, is further deformed by an increase in the anteroposterior diameter and a decrease in the transverse diameter. The external occipital protuberance is usually greatly enlarged

[1] Pedersen, H. E., and McCarroll, H. R. Vitamin-resistant rickets. *J. Bone & Joint Surg.*, January, 1951, *33-A*, 203–220.

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and the nose presents a typical saddle deformity.

Pedersen and McCarroll classify the roentgenographic bone changes under three headings: changes in the general architecture of the bone, alterations in the epiphyseal structures, and the deformities in the size and shape of the bones. In the cancellous bone of the metaphyseal areas, the trabeculae are coarser, broader, and more widely spaced. The epiphyseal lines are much broader. On the metaphyseal side of the epiphyseal line, the zone of calcification may be even and abrupt; but the usual finding is an irregular calcification giving a "woolly" or fuzzy appearance. These authors made an interesting observation in that all the epiphyseal lines showed a constant improvement following postoperative plaster immobilization. The adults generally complain of low-back pain and pain in the knees and hips. Their vertebrae are characteristically biconcave in both views with biconvex intervertebral discs. Those with the greatest deformities also have marked degenerative changes about the neck and hips and lumbosacral spine. There is an increased bony mass at the site of the attachments of the major muscles.

The laboratory studies were those characteristic of rickets without other abnormalities. The maximum inorganic phosphorus level was 3.3 milligrams per 100 cubic centimeters of serum. The serum calcium was normal or slightly below. The serum alkaline phosphatase was elevated to between 15 and 20 or more Bodansky units in the great majority of patients. The urine analyses were all within normal limits.

The etiology or location of this metabolic disturbance is uncertain. Albright demonstrated that there was no response to usual intravenous quantities of vitamin D, and others have shown there was a lack of response at the blood levels many times above normal. Another group suggested the renal tubule as the site of the disease. However, definite parathyroid hyperplasia is known to exist in rickets, and Albright points out that the increased phosphorus excretion in rickets is probably due to parathyroid activity. He feels that there is a threshold effect in vitamin-resistant rickets and, that there is no response to vitamin D until the threshold is reached, while above that level the response is normal.

Pedersen and McCarroll treated their patients according to two plans. In the first plan patients were hospitalized and treated vigorously in an effort to produce the maximum safe response and to elevate the serum phosphorus levels to normal. In the second plan the out-patients were treated with smaller doses of vitamins and checked at monthly intervals. Treatment was started empirically with 300,000 units daily, with revisions upward or downward depending upon the effect desired. The dosage in out-patients was increased or decreased to maintain a Sulkowitch test of 1 or 2 plus. With patients in the hospital the dosage was increased until the inorganic phosphorus reached 5 milligrams per 100 cubic centimeters or until toxic symptoms appeared. In this group the Sulkowitch was allowed to reach 4 plus for short periods if necessary. Actually the dosage must be established for each patient by trial and error. When an adequate response has been obtained the maintenance dose for each patient is then determined in a similar manner. It was found to be approximately one-half to one-third of the initial requirement.

With the employment of such large doses they warn that each patient must be carefully followed by determinations of the blood and urine calcium and inorganic phosphorus to prevent overdosage with subsequent toxicity, metastatic calcification and even irreparable kidney damage. In the management of these cases the physician must be familiar with the clinical signs of toxicity which are anorexia, nausea, vomiting, weight loss, occasionally hematuria, and rarely oliguria or anuria associated with nephrocalcinosis.

Of the 25 children all had a history of rickets beginning in infancy and each had been treated with large doses of vitamin D but, in spite of this, their bones had the characteristic appearance of those seen in florid rickets. The original treatment had usually consisted of 20–75 drops of a cod liver oil concentrate daily or that fortified with percomorph oil. None of the children had an abnormal dietary history or a gastrointestinal disease.

The response to treatment is extremely variable in different patients yet all of them showed typical chemical and roentgenographic changes. With adequate dosage of vitamin D, the serum inorganic phosphorus and urinary calcium rise, and the alkaline phosphatase gradually declines. Changes in urinary calcium and serum inorganic phosphorus may be seen within a week, while roentgenographic changes do not appear for three or four weeks and than at the epiphyseal line. Here the first change is the calcification of the wide area of uncalcified osteoid tissue and cartilage which has been built up at the epiphyseal line. The area of calcification increases in density and grows toward the epiphysis until a normal narrow regular epiphyseal line has developed, and until mineralization in the metaphysis becomes homogeneous. They have not followed any patient long enough to demonstrate alterations in the coarse thick trabeculae of the bone.

Patients with vitamin-resistant rickets are differentiated from those with renal acidosis and the Fanconi syndrome by decreased urinary calcium excretion, the absence of glucose albumin and amino acids in the urine and the absence of disturbed plasma electrolites.

Radiologists must be familiar with this disorder in order to distinguish it from conditions which have been incorrectly classified as achondroplasia, dyschondroplasia, chondrodysplasia, or a combination of these diseases with rickets. The roentgenographic examination of these conditions and the diagnosis of vitamin-resistant rickets must be kept in mind as it can be definitely established by urine and blood chemistry studies. It represents perhaps the most common cause of dwarfism and has a strong familial tendency. The characteristic photographs and roentgenograms of the patients with vitamin-resistant rickets are worth studying by viewing the reproductions in the original article by Pedersen and McCarroll. Once again the frontier of ignorance has been pushed back a little farther to give us a better understanding of at least one of the disorders in the very complex group of chondrodystrophies.

Wendell G. Scott, M.D.

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ALFRED J. ACKERMAN
1907–1950

ALFRED J. ACKERMAN died on August 18, 1950. His untimely death at the age of forty-three was preceded by a year of invalidism. He was a native of Poland and was graduated from the University of Vienna in Austria. After receiving

post-graduate training in roentgenology, he came to the United States in February, 1935. He spent a year at the Vanderbilt Clinic of Columbia University in New York, after which he moved to Oklahoma City. Here, he received an appointment as Resident Roentgenologist at the University of Oklahoma. By 1942, he had been advanced to the position of associate professor at which time he entered the armed forces. Before his illness, he had attained the rank of Lieutenant Colonel in the regular army, and was chief of the Roentgenological Service at Brooke General Hospital, Fort Sam Houston, Texas. He was elected to membership in the American Roentgen Ray Society in 1948. Other professional memberships of major importance included the American College of Radiology, Radiological Society of North America, American College of Physiology and the American Medical Association.

Dr. Ackerman had no place in his life for insincerity. To the casual acquaintance he seemed "socially cool" and even at times unfriendly. To those of us who knew him well, "Ack" had a unique personality. He displayed an immeasurable faith in his friends and in their judgment, both professionally and socially. His acquaintances were many but his close friends few. Friendship once established became invaluable to him and an integrated part of his personality because he then became completely accepting. His approach to radiology was both practical and scientific. As an internist, I quickly learned to respect his opinion, even those opinions far removed from the field of radiology. He made a constant effort to correlate his observations with those of the clinician. Because of this, he possessed an uncanny diagnostic insight. This quality made him invaluable as an academician, particularly at the graduate level. He organized the residency training program in roentgenology at Brooke General Hospital in a superior fashion for which he received a citation for meritorious service. His death has been a great professional loss, and to his friends, a loss that cannot be adequately expressed.

JOHN H. MOYER, M.D.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. Barton R. Young, Germantown Hospital, Philadelphia 44, Pa. Annual meeting: Shoreham Hotel, Washington, D.C., Sept. 25–28, 1951.

American Radium Society
Secretary, Dr. J. E. Wirth, 635 Herkimer St., Pasadena 1, Calif. Annual meeting: Stevens Hotel, Chicago, Ill., June 8, 9 and 10, 1952.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 713 E. Genesee St., Syracuse 2, N. Y., Annual meeting: Palmer House, Chicago, Ill., Dec. 2–7, 1951.

American College of Radiology
Executive Secretary, William C. Stronach, 20 N. Wacker Drive, Chicago 6.

Section on Radiology, American Medical Association
Secretary, Dr. T. Leucutia, Harper Hospital, Detroit 1, Mich.

Alabama Radiological Society
Secretary, Dr. W. W. Anderson, Tuscaloosa, Ala. Meets time and place Alabama State Medical Association.

Arizona Radiological Society
Secretary, Dr. R. Lee Foster, 507 Professional Building, Phoenix, Ariz. Two regular meetings a year. The annual meeting at time and place of State Medical Association and interim meeting six months later.

Arkansas Radiological Society
Secretary, Dr. Fred Hames, 511 National Bldg., Pine Bluff, Ark. Meets every three months and also at time and place of State Medical Association.

Atlanta Radiological Society
Secretary, Dr. J. D. King, 35 Linden Ave., N.E., Atlanta, Ga. Meets monthly, except during three summer months, on second Friday evening.

Brooklyn Roentgen Ray Society
Secretary, Dr. J. J. Daversa, 345 75th St., Brooklyn, N. Y. Meets monthly fourth Tuesday, Oct. through April.

Buffalo Radiological Society
Secretary, Dr. Mario C. Gian, 610 Niagara St., Buffalo, N. Y. Meets second Monday evening each month, October to May inclusive.

Central New York Roentgen Ray Society
Secretary, Dr. Dwight V. Needham, 608 E. Genesee St., Syracuse N. Y. Meets January, May, November.

Central Ohio Radiological Society
Secretary, Dr. F. A. Riebel, 15 West Goodale St., Columbus, Ohio. Meets at 6:30 P.M. on second Thursday of October, December, February, April, and June at Columbus Athletic Club, Columbus, Ohio.

Chicago Roentgen Society
Secretary, Dr. B. D. Braun, 6 N. Michigan Ave., Chicago 2, Ill. Meets second Thursday of each month, October to April inclusive at the University Club.

Cleveland Radiological Society
Secretary, Dr. Mortimer Lubert, 10515 Carnegie Ave., Cleveland 6, Ohio. Meetings at 6:45 P.M. on fourth Monday of each month from October to April.

Colorado Radiological Society
Secretary, Dr. Paul E. RePass, 306 Republic Bldg., Denver 2, Colo. Meets third Friday of each month at University of Colorado Medical Center or at Denver Athletic Club.

Connecticut Valley Radiologic Society
Secretary, Dr. E. W. Godfrey, 1676 Boulevard, West Hartford, Conn. Meets second Friday Oct. and April.

Dallas-Fort Worth Roentgen Study Club
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meets in Dallas on odd months and in Fort Worth on even months, on third Monday, 7:30 P.M.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. J. C. Cook, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

East Bay Roentgen Society
Secretary, Dr. Dan Tucker, 434-30th St., Oakland 9, Calif. Meets first Thursday each month at Peralta Hospital, Oakland.

Florida Radiological Society
Secretary, Dr. Nelson T. Pearson, 1109 Huntington Bldg., Miami, Fla. Meets twice annually, in the spring with the annual State Society meeting, and in the fall.

Georgia Radiological Society
Secretary, Dr. R. C. Pendergrass, Americus, Ga. Meets in mid-winter and at annual meeting of Medical Association of Georgia in the spring.

Greater Miami Radiological Society
Secretary, Dr. T. M. Berman, 350 Lincoln Rd., Miami Beach, Florida. Meets last Wednesday of each month at 8:00 P.M. at Veterans Administration Regional Office.

Houston Radiological Society
Secretary, Dr. F. M. Windrow, 1205 Hermann Professional Bldg., Houston, Texas. Meets fourth Monday each month.

Illinois Radiological Society
Secretary, Dr. Wm. DeHollander, St. John's Hospital, Springfield, Ill. Meets three times a year.

Indiana Roentgen Society
Secretary, Dr. William M. Loehr, 712 Hume-Mansur Bldg., Indianapolis 4. Meets second Sunday in May.

Iowa X-Ray Club
Secretary, Dr. Arthur W. Erskine, 326 Higley Bldg., Cedar Rapids, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society.

Kansas Radiological Society
Secretary, Dr. Anthony F. Rossitto, Wichita Hospital, Wichita, Kan. Meets annually with State Medical Society.

Kentucky Radiological Society
Secretary, Dr. E. L. Pirkey, Louisville General Hospital, Louisville 2, Ky. Meets monthly on second Friday at Seelbach Hotel, Louisville.

Kings County Radiological Society
Secretary, Dr. Marcus Wiener, 1430-48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:45 P.M.

Los Angeles Radiological Society
Secretary, Dr. Wybren Hiemstra, 1414 S. Hope St., Los Angeles 15, Calif. Meets second Wednesday each month at Los Angeles County Medical Assn. Building.

Louisiana Radiological Society
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

Maine Radiological Society
Secretary, Dr. C. F. Miller, Central Maine General Hospital, Lewiston, Maine.

Miami Valley Radiological Society
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* Secretaries of societies are requested to send timely information promptly to the Editor.

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MILWAUKEE ROENTGEN RAY SOCIETY
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MINNESOTA RADIOLOGICAL SOCIETY
Secretary, Dr. L. A. Nash, 572 Lowry Medical Arts Bldg., St. Paul 2, Minn. Meets three times annually, once at time of State Med. Assn., and in spring and fall.

MISSISSIPPI RADIOLOGICAL SOCIETY
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NEBRASKA RADIOLOGICAL SOCIETY
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NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. L. L. Robbins, Massachusetts General Hospital, Boston, Mass. Meets monthly on third Friday, Harvard Club.

NEW HAMPSHIRE ROENTGEN RAY SOCIETY
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

NEW YORK ROENTGEN SOCIETY
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NORTH CAROLINA RADIOLOGICAL SOCIETY
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NORTH DAKOTA RADIOLOGICAL SOCIETY
Secretary, Dr. C. O. Heilman, 807 Broadway, Fargo. Meetings by announcement.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY
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OHIO STATE RADIOLOGICAL SOCIETY
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OKLAHOMA STATE RADIOLOGICAL SOCIETY
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OREGON RADIOLOGICAL SOCIETY
Secretary, Dr. C. T. Jessell, 214 Medical-Dental Bldg., Portland 5, Oregon. Meets monthly 2nd Wednesday, 8:00 P.M.

ORLEANS PARISH RADIOLOGICAL SOCIETY
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY
Secretary, Dr. S. J. Hawley, 1320 Madison St., Seattle 4, Wash. Meets annually in May.

PACIFIC ROENTGEN SOCIETY
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

PENNSYLVANIA RADIOLOGICAL SOCIETY
Secretary, Dr. J. M. Converse, 416 Pine St., Williamsport. Annual meeting: Bedford Springs Hotel, Bedford, Pa., May 16 and 17, 1952.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. G. P. Keefer, American Oncologic Hospital, Philadelphia 4, Pa. Meets first Thursday each month October to May, at 8:00 P.M., in Thomson Hall, College of Physicians.

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Secretary Dr. E. J. Euphrat, 3500 Fifth Ave., Pittsburgh 13, Pa. Meets 6:30 P.M. at Webster Hall Hotel on second Wednesday each month, October to May inclusive.

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RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY
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Secretary, Dr. L. J. Gibboney, 831 Carew Tower, Cincinnati 2, Ohio. Meets first Monday each month, at 7:30 P.M., September to May, inclusive.

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Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

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Secretary, Dr. Nicholas G. Demy, 912 Prospect Avenue, Plainfield, N. J. Meets annually at Atlantic City at time of State Medical Society and mid-winter at Elizabeth, N. J.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. George Gamsu, 191 S. Goodman St., Rochester, N. Y. Meets monthly on last Monday from September through May, 8 P.M. at Strong Memorial Hospital.

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY
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Secretary, Dr. Harold L. Shinall, St. Joseph's Hospital, Bloomington, Ill.

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Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

SOUTH BAY RADIOLOGICAL SOCIETY
Secretary, Dr. Charles E. Duisenberg, 300 Homer Avenue, Palo Alto, Calif. Meets second Tuesday each month.

SOUTH CAROLINA X-RAY SOCIETY
Secretary, Dr. Henry E. Plenge, Spartanburg General Hospital, Spartanburg, S. C. One meeting with South Carolina Medical Association in May, others arranged by President.

TENNESSEE RADIOLOGICAL SOCIETY
Secretary, Dr. J. M. Frère, Newell Hospital, Chattanooga,

Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. R. P. O'Bannon, 650 Fifth Ave., Fort Worth 4, Texas. Meets Houston, Texas, Jan. 18 and 19, 1952.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets first and third Thursdays 4:00 to 5:00 P.M., September to May inclusive. Room 203, Service Memorial Institute, 426 N. Charter St., Madison.

Utah State Radiological Society
Secretary, Dr. Angus K. Wilson, 343 S. Main St., Salt Lake City 1, Utah. Meets third Wednesday in September, November, January, March and May.

Virginia Radiological Society
Secretary, Dr. P. B. Parsons, Norfolk General Hospital, Norfolk, Va. Meets annually in October.

Washington State Radiological Society
Secretary, Dr. R. C. Kiltz, 705 Medical-Dental Bldg., Everett, Wash. Meets fourth Monday each month, October through May, College Club, Seattle.

Wisconsin Radiological Society
Secretary, Dr. Irving I. Cowan, 425 E. Wisconsin Ave., Milwaukee 2, Wis. Special meetings held during year; annual meeting each spring at Madison, Wis.

X-Ray Study Club of San Francisco
Secretary, Dr. M. A. Sisson, 450 Sutter St., San Francisco, 8, Calif. Meets Jan. to July, Lane Hall, Stanford Univ. Hospital; July to Dec. San Francisco Hospital.

Cuba, Mexico and Central America

Sociedad de Radiología y Fisioterapia de Cuba
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

Sociedad Mexicana de Radiologia y Fisioterapia
General Secretary, Dr. D. P. Cossio, Marsella No. 11, Mexico, D. F. Meets first Monday of each month.

Sociedad Radiológica Panameña
Secretary, Dr. L. Arrieta Sanchez, Apartado No. 86 Panama, R. de P. Meets monthly in a department of radiology of a local hospital, chosen at preceding meeting.

British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Ordinary meeting, on the Thursday preceding the third Friday, October to May at 8:15 P.M.
Medical Members' meeting, on third Friday in each month at 5:00 P.M., 32 Welbeck St., London, W 1.

Faculty of Radiologists
Honorary Secretary, Dr. J. F. Bromley, 45, Lincoln's Inn Fields, London, W.C.2, England.

Section of Radiology of the Royal Society of Medicine (Confined to Medical Members)
Meets third Friday each month at 4:45 P.M. at the Royal Society of Medicine, 1 Wimpole St., London.

Canadian Association of Radiologists
Honorary Secretary-Treasurer, Dr. Jean Bouchard, Suite 305, 1555 Summerhill Avenue, Montreal 26, Que. Meetings January and June.

Section of Radiology, Canadian Medical Association
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

Société Canadienne-Française d'Electrologie et de Radiologie Médicales
Secretary, Dr. Origéne Dufresne, 4120 Ontario St., East, Montreal, P. Q.

Australian and New Zealand Association of Radiologists
Honorary Secretary, Dr. Alan R. Colwell, 135 Macquarie St., Sydney, N.S.W.
Honorary Secretaries, State Branches:
New South Wales, Dr. E. W. Frecker, 135 Macquarie St., Sydney.
Victoria, Dr. T. L. Tyrer, 3 Lockerbie Court, East St. Kilda.
Queensland, Dr. J. Adam, 131 Wickham Terrace, Brisbane.
South Australia, Dr. R. de G. Burnard, 170 North Terrace, Adelaide.
Western Australia, Dr. A. M. Nelson, 179-B St. Georges Terrace, Perth.
New Zealand, Dr. E. G. Lynch, 12 Bolton St., Wellington.

South America

Asociacion Argentina de Radiologia
Secretary, Dr. Lidio G. Mocsa, Avda. Gral Paz 151, Córdoba, Argentina. Meetings held monthly.

Sociedad Argentina de Radiologia, Junta Central, Buenos Aires
Secretary, Dr. Oscar F. Noguera, Santa Fe 1171, Buenos Aires. Meetings are held monthly.

Sociedad Argentina de Radiologia, Filial del Litoral, Sede, Rosario
President, Dr. Francisco P. Cifarelli. Meets monthly second Wednesday, 19 ha 663 Italia St., Rosario, Santa Fe.

Sociedad Argentina de Radiologia, Filial del Sur, Sede, La Plata
President, Prof. Dr. Jose P. Uslenghi, La Plata. Meets monthly.

Sociedad Argentina de Radiologia, Filial del Centro, Sede, Cordoba
President, Prof. Dr. David L. Caro, Corro 86, Cordoba. Meets monthly.

Sociedad Argentina de Radiologia, Filial del Norte, Sede, Tucuman
President, Dr. Julio Mendez Valladares, Rivadavia 358, Tucuman. Meets monthly.

Sociedad Argentina de Radiologia, Filial de Cuyo Sede, Mendoza.
President, Dr. J. A. Orfila, Hospital Central, Mendoza. Meets monthly.

Sociedade Brasileira de Radiologia Medica
Secretary, Dr. Nicola Caminha, Av. Mem de Sa, Rio de Janeiro, Brazil. Meets monthly, except during January, February and March.

Sociedade Brasileira de Radioterapia
Secretary, Dr. Oscar Rocha von Pfuhl, Av. Brigadeiro Luiz Antonio, 644 São Paulo, Brazil. Meets monthly on second Wednesday at 9 P.M. in São Paulo at Av. Brigadeiro Luiz Antonio, 644.

Sociedad Colombiana de Radiologia
Secretary, Dr. Alberto Torres Focke, Av. 34, No. 17–34, Bogota, Colombia. Meets last Wednesday of each month.

Sociedad Peruana de Radiologia
Secretary, Dr. Julio Bedoya Paredes, Apartado, 2306, Lima, Peru. Meets monthly except during January, February and March, at Asociación Médica Peruana "Daniel A Carrión," Villalta, 218, Lima.

Sociedad de Radiologica, Cancerologia y Fisica Medica del Uruguay
Secretary, Dr. Arias Bellini, Av. Agraciada 1464, Piso 13, Montevideo, Uruguay.

Continental Europe

Société Belge de Radiologie
General Secretary, Dr. S. Masy, 111 Avenue des Allies, Louvain, Belgium. Meets monthly, second Sunday at Maison des Médecins, Brussels.

Société Française d'Electro-Radiologie Médicale, and its branches: Société du Sud-Ouest, du Littoral Méditerranéen, du Centre et du Lyonnais, de l'Ouest, de l'Est, et d'Alger et d'Afrique du Nord

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Secretary-General, Dr. A. Dariaux, 9 bis, Boulevard Rochechouart, Paris IX^{e}, France.

CESKOSLOVENSKA SPOLEČNOST PRO RÖNTGENOLOGII A RADIOLOGII V PRAZE
Secretary, Dr. Roman Bláha, Praha XII, stát. nemocnice, Czechoslovakia. Meets monthly except during July, August, and September. Annual general meeting.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland.

GDANSK SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Smigielska, Akademia Lekarska, Gdansk. Meets monthly last Sunday at 10:30, X-Ray Dept., Akademia Gdansk.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland. Meets monthly.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Oscar Meller, Str. Banual Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD. USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

SOCIEDAD ESPANOLA DE RADIOLOGIA Y ELECTROLOGIA
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT (SOCIÉTÉ SUISSE DE RADIOLOGIE)
Secretary, Dr. Max Hopf, Effingerstrasse 47, Bern, Switzerland.

SOCIETA ITALIANA DI RADIOLOGIA MEDICA
Secretary Prof. Mario Ponzio, Ospedale Mauriziano. Torino, Italy. Meets biannually.

INDIA

INDIAN RADIOLOGICAL ASSOCIATION
Secretary, Dr. R. F. Sethna, Navsari Building, Hornby Road, Bombay 1, India

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SEVENTH INTERNATIONAL CONGRESS OF RADIOLOGY, 1953

In accordance with the decision of the International Committee of Radiology which met in London in July, 1950, the Seventh International Congress of Radiology will be held in Copenhagen, Denmark, in 1953. The dates of the Congress will be July 19 to 25.

The officers for the Congress are as follows: *Honorary President*, Prof. Niels Bohr; *President*, Prof. P. Flemming Møller; *Vice-Presidents*, Dr. Sv. A. Chrom (Diagnosis), Dr. Jens Nielsen (Therapy), Prof. Carl Krebs (Biology), Prof. H. M. Hansen (Physics), Dr. E. de Fine Licht (Technical Section and Exhibition); *Treasurer*, Mr. Aage von Benzon, Banker; *Secretary-General*, Prof. Flemming Nørgaard.

Radiologists throughout the world will be welcome at the Congress. All national radiological societies are being asked to supply a list of their members, and full details about registration for the Congress will be sent to all radiologists individually as soon as they are available.

Correspondence should be addressed to the Congress Office at 10 Øster Voldgade, Copenhagen K, Denmark.

FLEMMING NØRGAARD
Secretary-General

PENNSYLVANIA RADIOLOGICAL SOCIETY

The Annual Meeting of the Pennsylvania Radiological Society will be held at Bedford Springs Hotel, Bedford, Pennsylvania, on May 16 and 17, 1952.

FOURTH ARGENTINE CONGRESS OF RADIOLOGY

At the closing meeting of the Third Argentine Congress of Radiology it was decided that the Fourth Argentine Congress of Radiology should be held in the City of Santa Fé, Argentina. Dr. Raúl Mayer, of Santa Fé, was elected chairman of the Congress.

AWARDS IN RADIOLOGY

At a special meeting of the Argentine Association of Radiology (Asociación Argentina de Radiológia) held during the Third Argentine Congress of Radiology two prizes were given. The Roentgen Gold Medal was awarded to Dr. Lidio G. Mosca of Córdoba. This prize is presented to the radiologist who has done the most outstanding research work in radiology. The Mentor Gold Medal was awarded to Dr. Quirno Codas Thompson of Asunción, Paraguay, for his twenty-five years of uninterrupted service as professor of radiology.

AMERICAN RADIUM SOCIETY

The Thirty-third Annual Meeting of the American Radium Society was held in Atlantic City on June 7, 8 and 9, 1951. The program consisted of an unusually diversified and well given group of papers. The annual Janeway Medal was presented to Dr. H. Dabney Kerr, of Iowa City, Iowa. His interesting and extremely timely Janeway Lecture was on "Some Thoughts on the Training of a Radiation Therapist."

Ninety-seven active members attended this meeting and there were one hundred and fifteen guest physicians attending the various programs of the meeting.

The next annual meeting of the American Radium Society will be held at the Stevens Hotel in Chicago on June 8, 9 and 10, 1952.

CLEVELAND RADIOLOGICAL SOCIETY

The newly elected officers of the Cleveland Radiological Society for the year 1950–1951 are as follows: *President*, Dr. John R. Hannan; *Secretary-Treasurer*, Dr. Mortimer Lubert.

NEW YORK ROENTGEN SOCIETY

At a recent meeting of the New York Roentgen Society the following officers were elected for the year 1951–1952 and will take office on September 1: *President*, Dr. Maurice Lenz; *Vice-President*, Dr. John L. Olpp; *Secretary*, Dr. Irving Schwartz; *Treasurer*, Dr. Ernest H. Wood.

SAN FRANCISCO RADIOLOGICAL SOCIETY

In May, 1951, a new society was established named the San Francisco Radiological Society. The following officers were elected: *President*, Dr. A. J. Williams; *President-Elect*, Dr. A. A. deLorimier; *Secretary-Treasurer*, Dr. Ivan J. Miller. The society will meet quarterly.

TENNESSEE RADIOLOGICAL SOCIETY

At the recent annual meeting of the Tennessee Radiological Society the following officers were elected for the year 1951–1952: *President*, Dr. Walter D. Hankins, Johnson City; *Vice-President*, Dr. J. E. Whiteleather, Memphis; *Secretary-Treasurer*, Dr. J. Marsh Frère, Chattanooga.

TESTIMONIAL DINNER FOR DR. JOHN D. CAMP

A testimonial dinner was given by the Minnesota and North Dakota Radiological Societies in St. Paul, Minnesota, on July 21, 1951, honoring Dr. John D. Camp, a roentgenologist at the Mayo Clinic, who has been a member of the Minnesota Radiological Society for twenty-five years. Dr. Camp is leaving the Mayo Clinic to begin practice at Los Angeles, California. He was presented with an inscribed silver tray by the members of the two societies.

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BOOK REVIEWS

Books sent for review are acknowledged under: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interest of our readers as space permits.

THE DIGESTIVE TRACT IN ROENTGENOLOGY. By Jacob Buckstein, M.D., Assistant Professor of Clinical Medicine, Cornell University Medical College; Visiting Roentgenologist (Alimentary Tract Division), Bellevue Hospital, New York City; etc. Cloth. Price, $18.00. Pp. 889, with 1,030 illustrations in 659 figures. J. B. Lippincott Company, East Washington Square, Philadelphia, Pennsylvania, 1948.

The present work began as a contribution to a series of monograph atlases entitled "Annals of Roentgenology," appearing in 1930 under the title of "Peptic Ulcer." They grew into an early larger volume entitled "Clinical Roentgenology of the Alimentary Tract," published by Saunders, and now appears in this much elaborated volume of nearly 900 pages and 1,030 illustrations in 659 figures, covering the entire digestive tract, including the spleen, liver and pancreas. The illustrations are especially to be commended, including not only the roentgenograms but numerous photographs of actual specimens referred to in the roentgenograms. The text is lucid and presented in a style which invites the reader. The bibliography for the most part is very complete up to the date of the first impression in 1948. There are some glaring omissions. We deal here with the second impression. The chapters on the small intestine are especially well done. It is an excellent, comprehensive textbook and reference manual.

JAMES T. CASE, M.D.

ESSENTIALS OF UROLOGY. By J. C. Ainsworth-Davis, M.A., M.D., B.Ch. (Cant.), F.R.C.S. (Eng. and Edin.), Urological Surgeon, The Bolingbroke Hospital, London; Visiting Urologist, Kettering and District General Hospital and the Lord Mayor Treloar's Hospital, Alton; etc. Cloth. Price, $10.00. Pp. 734, with 512 illustrations. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1950.

This single volume, 734 page textbook covers the subject of urology in a brief and easy to read manner. It is divided into seven sections.

In section 1, Ainsworth-Davis emphasizes the importance of a thorough knowledge of urinary symptoms and their clinical significance. It includes an analysis of various laboratory investigations, instrumentation and cystoscopy, roentgenography and renal function tests. The material is presented in a manner well adapted to the practitioner or student in urology. Twenty-six pages are devoted to roentgenography of the urinary tract. Examples of normal and abnormal roentgenograms and pyelograms are presented. These reproductions are retouched and they have the added disadvantage of being negative prints.

The six remaining sections in the book discuss urinary tract diseases and their treatment under separate anatomical divisions of the genitourinary tract. To this reviewer such anatomical division of subject material does not seem to be the most efficient method of teaching. Since many diseases may affect multiple anatomical sections, either structurally or functionally, there is an ever present danger of repetition or, even more serious, omission of important facts. Congenital anomalies, admittedly important in the etiology of surgical disease of the genitourinary tract, do not attain proper emphasis because they are divided in five different sections of the book. Important lesions, such as congenital valves of the posterior urethra and congenital fibrosis of the vesical neck as a cause of persistent pyuria in infants and children, are not mentioned. Pathological physiology of urinary tract disease is not dis cussed and pathological anatomy is overshadowed by treatment and detailed discussion of operative techniques.

In these respects the book is quite in accord with the author's intended purpose, namely, a treatise on the essentials of urology for the practitioner and student of urology. It could serve well as a reference book, but to the radiologist it adds little in the way of new information which might aid in roentgen diagnosis of urinary tract disease.

The publisher's choice of paper, format, and print are all of good quality.

GEORGE W. CHAMBERLIN, M.D.

Atti del XVI Congresso Nazionale di Radiologia Medica. Taormina 15–18 Maggio 1950. A cura del Prof. Ettore Castronovo, Messina. Volume I. Relazioni Ufficiali. Parte I. La radiodiagnostica dei tumori cerebrali. By Prof. Fermo Mascherpa. Paper. Pp. 125, with 124 illustrations. Tipografia Ditta d'Amico, Messina, Italy, 1950.

This monograph is the official report on the roentgen diagnosis of brain tumors presented before the XVI National Congress of Medical Radiology by Professor Fermo Mascherpa. It gives an excellent account of the present status of the various roentgenologic methods used and a comprehensive description of the many characteristic findings, the correct interpretation of which is important not only for the identification of the lesion but also for the localization of its site and, if possible, for the determination of its extent and pathologic nature.

The report is divided into a general and a special section. The first includes a detailed discussion of simple roentgenography, encephalography, cisternography, ventriculography and arteriography, with a comparative evaluation of their usefulness in the diagnosis of brain tumors in general and the differentiation from pseudotumors in particular. The typical arteriographic alterations are tabulated for the principal tumors.

In the special section the author compiles the pertinent roentgen findings for every possible anatomic site of the tumor. The following classification is used: (A) Supratentorial tumors: I, frontal; II, temporal; III, parietal; IV, occipital; V, marginal (extending toward the base of the skull); VI, sellar; VII, mid-cerebral; VIII, intraventricular, and IX, multiple; and (B) Subtentorial tumors involving I, the cerebellopontine angle; II, cerebellar hemispheres; III, vermis; IV, fourth ventricle, and V, the bulb.

In concluding, the author states that despite the enormous progress made during the last years in the roentgen diagnosis of cerebral tumors there are still two gaps present: (a) the inability to recognize even a very extensive tumefaction of an infiltrating character unless it is associated with a distortion or displacement of the ventricular cavities, and (b) the great difficulty to demonstrate a neoplasm in the early stage when treatment would be most useful.

The report is profusely illustrated with beautiful reproductions of simple roentgenograms, encephalograms, ventriculograms and many arteriograms attesting to the vast experience of the author and to his immeasurable interest in the subject.

T. Leucutia, M.D.

Atti del XVI Congresso Nazionale di Radiologia Medica. Taormina 15–18 Maggio 1950. A cura del Prof. Ettore Castronovo, Messina. Volume I. Relazioni Ufficiali. Parte II. La radioterapia dei tumori maligni del sistema reticoloendoteliale. By Prof. Giovanni F. Gardini. Paper. Pp. 78, with several illustrations and tables. Tipografia Ditta d'Amico, Messina, Italy, 1950.

In this second official report, Professor Giovanni F. Gardini deals in extenso with a group of tumors in which admittedly the greatest confusion exists not only as concerns the best method of treatment to be used but also with regard to the classification and even nomenclature of the various lesions constituting the group.

In introducing his subject the author, after a review of the many classifications collected from the literature, adopts the procedure of Professor Businco, his intimate collaborator, who places the tumors of the reticulo-endothelial system into three categories: (1) reticulo-endothelioma or reticulo-histiocytoma; (2) endothelioma; and (3) mixed reticulo-endothelioma. The tumors of the first category are subdivided as follows: (A) benign reticulo-endothelioma: (a) simple, (b) associated (1) with hemopoiesis, and (2) with storage (or thesaurismosis); and (B) malignant reticulo-endothelioma comprising (a) true reticulo-endothelial sarcoma, (b) polymorphous reticulo-endothelial sarcoma and (c) reticulo-endothelial sarcoma associated (1) with hemopoiesis and (2) with storage (or thesaurismosis). In the present report the author is concerned solely with the malignant forms of the reticulo-endothelioma; in other words, the reticulo-endothelial sarcomas. The series studied comprised 62 cases which were selected on the basis of very rigid histopathologic criteria.

The clinical features and various methods of treatment, among which roentgen therapy predominated, are discussed at length. The statistical data pertaining to age distribution, sex incidence, primary localization and therapeutic

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results are arranged in a tabular form. A tabular compilation of the case history résumés is also given by listing all 62 patients individually.

At the time of publication of the report, 55 per cent of the patients were dead and 45 per cent alive. In this latter group, however, there were only 2 patients who surpassed the five year period and another 6 who surpassed the three year period, so that the survival rate for the entire series will undoubtedly prove considerably lower when the five year limit for all patients has been exceeded. Relatively better results were obtained when the reticuloendothelial sarcoma arose from the tonsil, nasopharynx, subcutaneous tissue or solitary lymph nodes.

T. LEUCUTIA, M.D.

ATTI DEL XVI CONGRESSO NAZIONALE DI RADIOLOGIA MEDICA. Taormina 15–18 Maggio 1950. A cura del Prof. Ettore Castronovo, Messina. Volume I. Relazioni Ufficiali. Parte III. Radioterapia e radiobiologia dei tumori delle ossa. By Prof. Adamo Grilli, Aiuto Ordinario 1st. di Radiologia Med. Università di Roma, Direttore: Prof. E. Milani. Paper. Pp. 201, with 57 illustrations and numerous tables. Abruzzini Editore, Roma, Italy, 1950.

This is the third official publication of the XVI National Congress of Medical Radiology prepared by Professor Adamo Grilli of the University of Rome. It bears the title of "Radiation therapy and radiation biology of bone tumors," and although it constitutes a report, the author in fact laid before the Congress a treatise written with great authority and encompassing admirably the latest developments in a vast and difficult field.

The book is divided into two sections. The first, or general, section deals with the clinical features, classification, radiobiology and radiosensitivity of bone tumors. After discussing in considerable detail the classifications of the Bone Sarcoma Registry of the American College of Surgeons, of Geschickter and Copeland, of Coley and of Mottura, the author adopts a scheme which is based on criteria of histogenesis (osseous, stromal or hemopoietic), evolution (benign or malignant), and origin (metastatic or aberrant) of the tumor. According to this scheme the bone tumors are divided into (A) Primary tumors, (B) secondary tumors, and (C) tumors of aberrant or inclusion tissues. The primary tumors are subdivided into (1) tumors of the osseous tissue (malignant: osteogenic sarcoma; benign: osteoma, chondroma, giant cell tumor); (2) tumors of the stromal and vascular tissues (malignant: fibrosarcoma, reticulum cell sarcoma, Ewing's tumor; benign: fibroma, angioma), and (3) tumors of the hemopoietic tissue (myeloma). Among the aberrant and inclusion tumors are listed the tumors of thyroid or cortico-adrenal origin, adamantinoma and chordoma.

The second, or special, section comprises seven well balanced chapters in which the various types of bone tumors are discussed at length, especially as concerns the different methods of radiation therapy (including the isotopes) and the results that may be expected from them. The author's personal experience is based on 131 cases of bone tumors which were treated between 1940 and 1950 at the Institute of Radiology of the University of Rome. In addition, he carefully reviewed the world medical literature and made considerable use of the more recent salient American publications.

On the whole, the presentation is excellent and the illustrations which usually depict several follow-up phases of the lesion in the same figure, are of good quality.

T. LEUCUTIA, M.D.

MEDICAL PHYSICS. Volume II. Otto Glasser, Ph.D., F.A.C.R., Editor-in-Chief, Diplomate in Radiological Physics, American Board of Radiology; Professor of Biophysics, Frank E. Bunts Educational Institute; Head, Department of Biophysics, Cleveland Clinic Foundation; Consultant, U. S. Veterans Administration, Washington, D. C. Cloth. Price, $25.00. Pp. 1,227, with 978 illustrations. Year Book Publishers, Inc., 200 East Illinois Street, Chicago 11, Illinois, 1950.

This book, like its companion Volume I, is composed of a series of articles each written by an expert on the particular subject. These subjects are arranged alphabetically. Name and subject indexes at the end of the book assist the reader in finding particular information.

Volume II does not attempt to cover the whole field of medical physics. Some of it has been adequately covered in Volume I. If the material of Volume I is considered adequate, only the title is listed in Volume II. Where minor additions would bring a subject up to date, only these additions are included in Volume II, but where considerable new in-

formation is available, these subjects have been entirely rewritten. While the editor warns that some material had to be left out because of space limitations, the material included seems well chosen.

The articles provide adequate introductions to their subjects for most persons with a physics background but who are not experts in the field. On the other hand, the articles give an adequate picture of the present knowledge on the subject. In addition each article contains numerous references so that the reader can cover a subject to any desired degree within the limits of current literature.

A partial list of major subjects giving an idea of breadth of coverage in the present volume includes: anesthesia, aviation medicine, circulatory systems, Geiger counters, genetics, isotopes, optics, radiation, respiratory system and sound. Many professional people, therefore, will find reference material of interest in Medical Physics.

Harold O. Wyckoff

Enzymes, Growth, and Cancer. By Van R. Potter, Ph.D., Professor of Oncology, University of Wisconsin Medical School, Madison, Wisconsin. Fabrikoid. Price, $1.85. Pp. 64. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1950.

The author presents five premises of the general role of enzymes in health and disease and then specifically as related to the problem of cancer. In the third of his five premises, he attempts a theory of cancer formation. In the terms of enzymes, cancer cells may be produced in either of two ways: by a "deletive pattern," in which one or more enzymes may be lost from a normal cell and the cancer cell produced, or by an "addition pattern" by which some enzyme not possessed by normal cells may be gained in the cancer cells. The first view is favored. That even very small changes in enzyme composition and concentration may result in marked alteration of cellular activity is well shown.

The role of chemotherapeutic drugs as enzyme inhibitors or competitors limiting various enzyme concentrations or substrate concentrations by chemical transformation or competition is outlined. This reveals the difficulty in picking one compound which may yield desired results and why either chance observation or painstaking investigation is necessary to find effective ones. Even though a cancer cure may not result from such studies, the understanding of living cellular functions will be well worth the effort spent.

The publisher, Charles C Thomas, has prepared a small book which in every way measures up to the high standard he has set for his books.

Eugene P. Pendergrass, M.D.

BOOKS RECEIVED

Chest X-ray Diagnosis. By Max Ritvo, M.D., Assistant Professor of Radiology, Harvard Medical School; Instructor in Radiology, Tufts Medical School; etc. Cloth. Price, $15.00. Pp. 558, with 418 illustrations and 1 colored plate. Lea & Febiger, Washington Square, Philadelphia 6, Pennsylvania, 1951.

A Pneumographic Study of the Temporal Horn, with Special Reference to Tumours in the Temporal Region. Acta radiologica, Supplementum LXIX. By Erik Lindgren. Paper. Price, Swedish Crowns 25:-. Pp. 151, with 239 illustrations. P. A. Norstedt & Söner, Stockholm, Sweden, 1948.

La pratique stomatologique. Publiée sous la direction du Dr. Chompret par les docteurs Béliard, Bercher, Bertrand, Chompret, Dalbanne, Dechaume, Fargin-Fayolle, Fleury, Friez, Guilly, Humbert, Izard, Lacaisse, Lacronique, L'Hirondel, P. Nespoulous, Ponroy, Psaume, Raison, Richard, Rousseau-Decelle, Thibault, Vilenski. IX Radiographie bucco-dentaire et agents physiques en stomatologie. Par P. Bertrand, M. Dechaume, et G. Lacronique. Deuxième édition. Cloth. Price, 1800 fr. Pp. 523, with 568 illustrations. Masson et Cie, 120, boulevard Saint-Germain, Paris 6e, France, 1950.

Handbook of Pediatric Medical Emergencies. By Adolph G. DeSanctis, M.D., Professor of Pediatrics and Chairman of the Department of Pediatrics, Post-Graduate Medical School, New York University-Bellevue Medical Center, etc.; and Charles Varga, M.D., Instructor in Pediatrics, Post-Graduate Medical School, New York University-Bellevue Medical Center, etc. Cloth. Price, $5.00. Pp. 284, with 51 illustrations. C. V. Mosby Company, 3207 Washington Boulevard, St. Louis 3, Missouri, 1951.

Physiology of the Eye. Clinical Application. By Francis Heed Adler, M.A., M.D., F.A.C.S., William F. Norris and George E. de Schweinitz Professor of Ophthalmology, School of Medicine, University of Pennsylvania, and Consulting Surgeon, Wills Hospital, Philadelphia. Cloth. Price, $12.00. Pp. 709, with 319 illustrations including 2

in color. C. V. Mosby Company, 3207 Washington Boulevard, St. Louis, Missouri, 1950.

Principles and Practice of Surgery. By Jacob K. Berman, A.B., M.D., F.A.C.S., Associate Professor of Surgery, Indiana University School of Medicine; Associate Professor of Oral Surgery, Indiana University School of Dentistry; etc. Cloth. Price, $15.00. Pp. 1,378, with 429 illustrations. C. V. Mosby Company, 3207 Washington Boulevard, St. Louis, Missouri, 1950.

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Oral and Facial Cancer. By Bernard G. Sarnat, M.D., F.A.C.S., Professor and Head of the Department of Oral and Maxillofacial Surgery, College of Dentistry, etc.; and Isaac Schour, D.D.S., Ph.D., Sc.D., Coordinator of Cancer Instruction, Professor and Head of the Department of Histology and Associate Dean in Charge of Postgraduate Studies, University of Illinois College of Dentistry, Chicago. With a Foreword by Andrew C. Ivy, Ph.D., M.D., D.Sc., Vice-President in Charge of Chicago Profesional Colleges, University of Illinois, etc. Cloth. Price, $6.00. Pp. 300, with 118 illustrations and 2 color plates. Year Book Publishers, Inc., 200 East Illinois Street, Chicago 11, Illinois, 1950.

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Cancer of the Colon and Rectum. Its Diagnosis and Treatment. By Fred W. Rankin, B.A., M.A., M.D., LL.D., Sc.D., F.A.C.S., Surgeon, St. Joseph's and Good Samaritan Hospitals, Lexington, Kentucky; Clinical Professor of Surgery, University of Louisville, Louisville, Kentucky; and A. Stephens Graham, M.D., M.S. (in Surgery), F.A.C.S., Surgeon, Stuart Circle Hospital, Richmond, Virginia; Associate Professor of Surgery, Medical College of Virginia. Second edition. Cloth. Price, $7.50. Pp. 427, with 148 illustrations. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1950.

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Vol. 66, No. 3

ABSTRACTS OF RADIOLOGICAL LITERATURE

Department Editor: T. Leucutia, M.D., Harper Hospital, Detroit 1, Michigan

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ROENTGEN DIAGNOSIS

HEAD

TEBO, HEYL G., and TELFORD, Ira R. An analysis of the variations in position of the mental foramen. *Anat. Rec.*, May, 1950, *107*, 61–66.

This study, based upon observations made on 100 unselected, unsexed, adult, dentulous mandibles was stimulated by "repeated failures to locate the mental foramen in injection procedures," and by discrepancies in location of the foramen as stated by standard anatomical texts. The investigation was divided into two parts (a) to determine the relation of the mental foramen to the lower bicuspid teeth, and (b) to determine the relation of the mental foramen to the body and ramus of the mandible.

The illustration reproduced herewith (Fig. 1) shows graphically the relationship of the foramen to the cuspid, bicuspid and molar teeth in 87 mandibles. The findings indicate that the most common location is at the apex of the lower second bicuspid tooth and that the usually described relationship, between the apices of the lower bicuspid teeth, held in only about one-fourth of the mandibles studied.

Using the horizontal plane as defined by Morant,[1] the authors found the foramen to be approximately one-fourth of the distance from the symphysis menti to the posterior border of the ramus of the mandible. Consequently they suggest that this relationship is a more convenient method of locating the foramen in clinical practice than the usually accepted and, in their study, erroneous concept that the foramen is located between the apices of the lower bicuspid teeth.

Attention is drawn to the fact that the foramen may lie as far posteriorly as the first molar tooth; failure to recognize this fact could lead to erroneous interpretation of a normal structure.—*A. K. Wilson, M.D.*

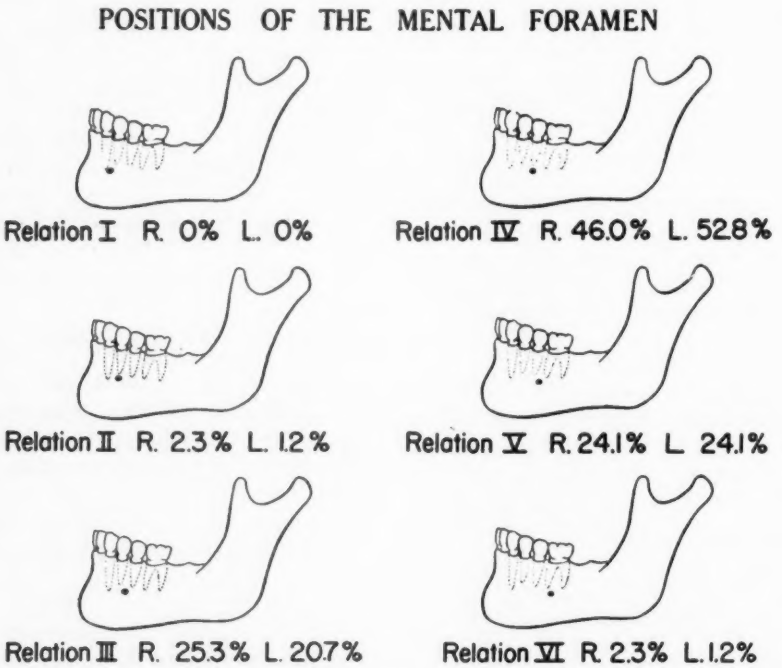
POSITIONS OF THE MENTAL FORAMEN
Relation I R. 0% L. 0%
Relation IV R. 46.0% L. 52.8%
Relation II R. 2.3% L. 1.2%
Relation V R. 24.1% L. 24.1%
Relation III R. 25.3% L. 20.7%
Relation VI R. 2.3% L. 1.2%

FIG. 1. Relation of the mental foramina to the lower teeth expressed in percentages as found in 87 mandibles. (Reproduced by permission from the original article by H. G. Tebo and I. R. Telford, *Anat. Rec.*, May, 1950, *107*, 61–66.)

OLIVECRONA, H. Die arteriovenösen Aneurysmen des Gehirns. (Arteriovenous aneurysms of the brain.) *Deutsche med. Wchnschr.*, Sept. 8, 1950, *75*, 1169–1173.

The arteriovenous aneurysms of the brain are congenital malformations. A conglomeration of pathological vessels is interspersed between arterial and venous system. The afferent arteries hypertrophy and the efferent veins become arterialized.

The first symptoms usually occur in the second and third decades of life. Epileptic seizures and subarachanoid or intracerebral hemorrhage are the most important symptoms.

In selecting the method of therapy one must

[1] Morant, G. M. Biometric study of the human mandible. *Biometricka*, 1936, *28*, 84–122.

consider the fact that radiation therapy or ligation of the vessels visible in the scalp are probably of no value. Ligation of the carotid artery is risky and causes hemiplegias in many cases. The choice is between surgical removal of the abnormal vessels or purely symptomatic treatment.

In 53 of the author's 87 cases, surgical extirpation was resorted to. The mortality was 9.4 per cent. Fifty-one per cent of the patients were well after surgery; 22.6 per cent were improved, but with remaining symptoms and partially disabled; 11 per cent were alive and totally disabled. One-fourth of the patients in whom surgical removal was not done died later from brain hemorrhage. Another one-fourth remained essentially well; one-third of them remained or became totally disabled.—*H. W. Hefke, M.D.*

Young, Barton R. Roentgen findings in tumors of the skull. *Radiology*, Sept., 1950, *55*, 321–326.

Conventional roentgen examination of the skull makes possible a diagnosis of many cranial and intracranial tumors. Many tumors produce changes sufficiently characteristic for diagnosis whereas others cause manifestations that indicate the necessity of further study.

Cysts of the skull are usually post-traumatic. There may be expansion of either table. More often there is a smooth elevation of the outer table and a sharply defined sclerotic cyst margin.

Osteomas occur more frequently than other benign tumors and usually arise in the fronto-ethmoid region. Hyperostosis is a bony overgrowth of the inner table and not a true tumor. An osteochondroma is a very rare tumor and usually found in the base of the skull. It is slow-growing, and produces symptoms of displacement and pressure erosion.

Epidermoids and cholesteatomas arise in the diploe and present a characteristic roentgen appearance of a sharply marginated area of rarefaction expanding either one or both tables. Cholesteatoma of the middle ear is the result of an ingrowth of the epithelium of the external auditory meatus into the middle ear and is manifest as a sharply marginated area of rarefaction in the tympanic cavity and mastoid antrum.

An oval radiolucent shadow in the region of the corpus callosum is most likely a lipoma of the brain. The periphery of this tumor may be calcified. Rarely, a dermoid may be the cause of a midline intracranial zone of radiolucency.

Hemangioma of the cranial bones is rare and may be the more common honeycomb type with sharp borders or the diffuse variety with greatly enlarged vascular channels. Angiography is of aid in making this diagnosis. Giant cell tumors and fibromas are very rare and when present usually involve the maxillae and mandible.

Meningiomas frequently produce changes in the bone adjacent to the tumor such as hyperostosis or focal erosion or a combination of the two. Occasionally the tumor contains enough calcium for visualization. Common sites are the vault and base.

A chordoma arises from remnants of the notochord in the base of the skull and produces extensive destruction of the floor of the middle fossa. Basal and lateral views usually reveal the inferior margin of the tumor in the nasopharynx.

The most common cause of sellar erosion is an adenoma of the pituitary. It depresses the floor and sometimes breaks through into the sphenoid sinus. The dorsum presents a shell-like configuration in contrast to erosion of the top of the dorsum from pressure by either an extrasellar tumor or hydrocephalus of the third ventricle. Flocculent calcification in the brain immediately above the expanded sella is characteristic of the craniopharyngioma.

About 60 per cent of patients with acoustic tumors will show erosion of the petrous ridge and apex and expansion of the internal auditory meatus and porus acusticus internus. Detection of these changes is not always easy due to the normal variations in the petrous ridge.

The skull is frequently involved by tumors that metastasize to the skeleton. These lesions are usually osteolytic. Metastatic disease from a carcinoma of the prostate is usually osteoblastic. Less frequently, breast carcinoma, Ewing's tumor, neuroblastoma and Hodgkin's disease cause osteoblastic changes in the skull.—*E. M. Cooper, M.D.*

Mullen, Wylie H., Jr., and Hannan, John R. Roentgen diagnosis of lipoma of the corpus callosum; report of a case. *Radiology*, Oct., 1950, *55*, 508–516.

This is a report of a surgically verified lipoma of the corpus callosum. This benign fat tumor was visualized on both posteroanterior and lateral plain roentgenograms of the skull. The tumor was ovoid in shape, radiolucent, located in the midline in the vicinity of the corpus callosum, and outlined by thin lines of calcification. Encephalograms showed separation of the lateral ventricles by the tumor. The tumor made a concave impression on the lateral ventricles and caused dilatation of the lateral and third ventricles.

Agenesia of the corpus callosum is commonly associated with the presence of a lipoma but in this case the corpus callosum was intact.

One of the main differential features is that in simple agenesia of the corpus callosum the third ventricle rises up to a level almost between the bodies of the widely separated lateral ventricles while when a lipoma is present in this region it prevents the third ventricle from ascending to any appreciable extent.

It is important that the radiologist recognize this rare brain tumor for once the diagnosis is established

it is generally agreed that surgical removal is contraindicated because of the frequent inclusion of both anterior cerebral arteries within the tumor.—*C. A. Stevenson, M.D.*

LIST, CARL F. Cerebral angiography. *Radiology*, Sept., 1950, *55*, 327–329.

The indications for cerebral angiography are vascular intracranial lesions such as arterial occlusion, aneurysm, arteriovenous fistula and arteriovenous malformation. The examination also has value in localization and at times differential diagnosis of intracranial tumors.

The contraindications are advanced hypertension and arteriosclerosis, extreme old age, recent vascular occlusion and blood dyscrasias. The examination may be used in selected cases of subarachnoid or intracerebral hemorrhage. In clinically non-localized lesions air studies are superior to this procedure.

Properly executed the examination carries practically no risk but should only be done by competent radiologists and neurologists who have a complete neurosurgical department to work with.

Findings in Vascular Lesions:

1. Occlusion—complete absence or marked narrowing of a major cerebral artery.
2. Aneurysms—sac usually fills with the opaque medium but because of clot the aneurysm is usually larger than visualized.
3. Arteriovenous fistula—usually between the carotid artery and cavernous sinus with very little opaque medium in the cerebral arteries and tremendous dilatation of the efferent veins.
4. Arteriovenous malformations—enlarged and tortuous arteries and veins with or without many small capillary connections.

Findings in Intracranial Tumors:

1. Epidural tumors or subdural hematoma will displace cortical vessels away from the inner table leaving an avascular space.
2. Tumors of various lobes show localized vascular displacement.
3. An area of complete avascularity may indicate a cyst, abscess, hematoma, or epidermoid.
4. Forty per cent of glioblastomas have a very rich blood supply. An irregular vascular pattern with "micro-aneurysms" and sinusoids is almost pathognomonic for this type of neoplasm.
5. Meningiomas may have a blood supply from the internal and external carotid arteries. Fine brush-like capillaries are seen in the late arterial phase of filling.—*C. A. Stevenson, M.D.*

HODGES, FRED JENNER. Cerebral aerography. *Radiology*, Sept., 1950, *55*, 330–336.

This is a thorough presentation of the indications, contraindications, technique and diagnostic yield of encephalography and ventriculography.

Encephalography is the method of choice when a surface lesion of the brain is suspected and when the intracranial pressure is within normal limits. Because it is impossible to completely drain all fluid from the ventricles, at least six different positions must be used so that the air can be made to fill all potentially patent areas. Numerous illustrations are presented to show the necessity of these various positions of the head. The author advocates a single exposure to determine if sufficient air is present before making the six or more pair of stereoscopic roentgenograms.—*C. A. Stevenson, M.D.*

FARQUHAR, H. G. Congenital toxoplasmosis; report of two cases in twins. *Lancet*, Nov. 18, 1950, *2*, 562–564.

This is a case report of a set of twins, eight months of age. The infection was probably acquired after birth. One had the typical tetralogy of congenital toxoplasmosis: cerebral calcification, hydrocephalus, chorioretinitis, and a positive serological test for toxoplasma antibodies. The other twin had no clinical evidence of the disease, except for mild ocular changes, but did have a similar titer of antibodies. The antibody titer in the mother was lower.—*Joseph Levitin, M.D.*

RILEY, IAN D., and ARNEIL, GAVIN C. Toxoplasmosis complicated by chickenpox and smallpox; report of a case. *Lancet*, Nov. 18, 1950, *2*, 564–565.

This is a case report of a nine months old girl who had the features of a congenital type of toxoplasmosis of (1) maculopapular eruption when six weeks of age, (2) microcephaly with asymmetry of the skull and premature synostosis, (3) bilateral chorioretinitis with pigmentary derangement, left-sided microphthalmus, sixth-nerve palsy, and iritis, (4) convulsions, (5) diffusely scattered areas of calcification throughout the brain, and (6) positive serological findings.

The mother also had positive serology, but was asymptomatic.

The child showed improvement until she later developed chickenpox; while recovering from chickenpox, she was in contact with a case of smallpox. She contracted the disease and died.—*Joseph Levitin, M.D.*

NECK AND CHEST

BROWN, ROSWELL K., and BROWN, ENID C. Congenital esophageal anomalies; review of twenty-four cases and report of three. *Surg., Gynec. & Obst.*, Nov., 1950, *91*, 545–550

Esophageal atresia should be suspected when a newborn has much mucus in the throat with feeding

difficulties and bronchopneumonia. It is proved by obstruction to passage of a catheter and by roentgen examination.

Ten years' experience (1940 to 1949) with esophageal anomalies at the Buffalo Children's Hospital is summarized (represented by a total of 24 cases).

In cases of imperforate anus with abdominal distention during the first two days of life a coexistent tracheoesophageal fistula should be suspected.

Surgical correction offers the only hope of survival and should be undertaken within the first few days of life.

The management of choice for the most frequent anomaly is an extrapleural operation through the bed of either the third or fourth rib on the right side with closure of the tracheal fistula and end-to-end anastomosis of the esophagus. This is followed by gastrostomy a day or two later.

Insufflation of the esophagus with oxygen while the anastomosis is inspected under physiologic saline solution is offered as a useful but not infallible test of the competence of the suture line.

The occurrence of several cases within a period of a few months suggests that the anomaly may be environmental rather than truly hereditary. Search for possible etiologic factors during the early weeks of gestation seems warranted.—*Mary Frances Vastine, M.D.*

Langston, H. T., Tuttle, W. M., and Patton, T. B. Esophageal duplications. *Arch. Surg.*, Nov., 1950, *61*, 949–956.

Report of two cases: (1) A female, aged two, had been subject to respiratory distress and infections since the age of eight months. A non-tender mass was noted on the left side medial to the sternomastoid muscle bulging on forced expiration or cough. The roentgenograms showed widening of the superior mediastinum and displacement of the trachea to the right; the esophagus was displaced posteriorly. A cyst 5.5 by 3.2 by 1 cm. was removed surgically. Histopathologically the walls of the cyst showed the pattern of the alimentary canal.

(2) A male, aged twenty-five, on routine roentgen examination presented a tumor on the right side of the mediastinum which did not respond to roentgen therapy. The mass extended from the inner end of the clavicle along the mediastinum to the diaphragm. At surgical exploration a large tubular mass was found connected to the neck by a fibrous cord and extending beneath the azygos vein along the hilus to the diaphragm. It was fixed to the diaphragm, but passed beneath it into the abdomen. It resembled a normal esophagus, but since a Levin tube was present in the normal esophagus it was readily distinguishable. The tubular mass was removed from the neck to the diaphragm, but it did not appear feasible to open the diaphragm to remove also the lower portion at this time. The lower segment was therefore filled with 10 cc. of an opaque solution and the end of the tube closed. The tubular mass removed gave to some extent the appearance of a normal esophagus. Histopathologically it resembled the alimentary tract. The patient would not submit to a planned laparotomy for removal of the abdominal portion of the mass which as determined by the opaque solution previously injected terminated at the level of the twelfth dorsal vertebra on the right side and it did not appear to communicate with the gastrointestinal tract.

Because of the histopathologic findings the two cyst-like structures reported above are considered to be examples of duplication of the esophagus with cyst formation.—*R. K. Arbuckle, M.D.*

Cardullo, Hugo M., and Berens, David L. Tracheoesophageal fistula unassociated with atresia or stenosis; difficulties in diagnosis and suggestions for greater accuracy. *New England J. Med.*, Nov. 30, 1950, *243*, 853–856.

A case report of congenital tracheoesophageal fistula without esophageal atresia is presented. This was demonstrated with 35 per cent solution of diodrast. The finding could not be reproduced with lipiodal because the fistulous communication was too small for the oil to pass through it. The use of diodrast is suggested as an aid to the early diagnosis of such conditions.—*F. B. Markunas, M.D.*

Buffmire, Donald K., Clagett, O. Theron, and McDonald, John R. Papillomas of the larynx, trachea and bronchi: report of case. *Proc. Staff Meet., Mayo Clin.*, Oct. 11, 1950, *25*, 595–600.

Papillomas are fairly common in the larynx but the simultaneous occurrence of papilloma in the larynx, trachea and bronchi is very rare.

The authors present a case with a prolonged history of a male, aged twenty-five, first seen in 1925 with papillomas of the larynx. These were removed yearly and the patient also had roentgen therapy. By 1931 papillomas were also present in the trachea, and in 1943 they were removed from the right main bronchus. In 1949 there was an ulcerating squamous cell carcinoma in the larynx with metastases to the cervical region and infiltration in the left lower lobe. Because of an increase in the size of the pulmonary lesion the lower lobe was removed in 1950 and there was a papillary squamous cell carcinoma almost completely obstructing the bronchus.

They believe the malignant components of the two tumors were completely separate since (1) if the lung lesion were embolic it would have been infiltrating rather than papillary, and (2) if due to inspiration of material from the larynx it is probable that more patients with laryngeal papillomas would

have tracheal and bronchial lesions.—*Martha E. Mottram, M.D.*

TAYLOR, GRANTLEY W., and WALLACE, RICHARD H. Carcinoma of the breast; fifty years experience at the Massachusetts General Hospital. *Ann. Surg.*, Oct., 1950, *132*, 833–843.

Approximately 2,500 primary cases, of which approximately 2,000 were submitted to radical mastectomy are considered. The series extended over a fifty year period beginning in 1894. The operability rate throughout the half century ranged from 72 to 80 per cent of all the primary cases admitted to the hospital. There has been a definite increase in the number of favorable cases making for a higher operability rate. The disease is being discovered earlier and physicians of the community are referring cases more promptly for operation. The ratio of cases without axillary lymph node metastases has definitely increased.

The criteria of operability remains essentially the same as originally reported.

The improvement in general surgical technique, preparation, anesthesia and after-care has reduced the postoperative mortality from 3.6 per cent in the original series to 0.65 per cent in the current series.

The incidence of recurrences in the operative field has steadily decreased and in the present series is 11 per cent.

Postoperative lymphedema of the arm has decreased and now occurs in less than 10 per cent of the cases.

The "cures" in the entire group are 51 per cent, including 77 per cent of cases without axillary node involvement and 33 per cent of cases with axillary metastases. In recent years when only one or two lymph nodes were involved, "cures" resulted in 76 per cent of the cases.

The authors state that they use roentgen therapy only in recurrent and inoperable cases and in those instances when the surgeon is convinced that he has had to leave gross disease behind at the time of operation.

They conclude that at the present time radical mastectomy may be expected to result in a five year "cure" in about half of the cases submitted to operation.—*C. P. Truog, M.D.*

HORNE, HERBERT W., JR. The "milk factor" in carcinoma of the human breast; an analysis of 88 cases. *New England J. Med.*, Sept. 7, 1950, *243*, 373–375.

This study represents a painstaking investigation of a group of patients with and without breast carcinoma. Its purpose was to determine the possibility of transfer of an agent through breast feeding that might be a factor in the development of mammary cancer. It has been shown experimentally in mice that a minimal quantity of infected milk can transmit the neoplastic tendency to the female offspring.

A group of 88 patients with known carcinoma of the breast, whose mothers were still living, composed a part of the material for the study. Another group of 86 patients who had vaginal plastic operations and in whom no evidence of neoplastic disease was evident from the history, physical examination or pathological study composed the control group. The average age of both groups was the same (41.3 years).

The incidence of absence of breast feeding in the cancer group was 10.2 per cent and in the non-cancer group 8 per cent. The study also demonstrated that, in the cancer group (exclusive of the patient's neoplasm), the maternal family history elicited that there were 87 tumors of which 20 were known cancers; in the non-cancer group the maternal family history elicited 35 tumors of which 14 were known cancers.

From this investigation the author concludes that a woman may develop cancer of the breast without ever having received any human breast milk.—*W. W. Maver, M.D.*

PORTMANN, U. V. Cancer of the breast: classification of cases, criteria of incurability and treatment. *J.A.M.A.*, Oct. 14, 1950, *144*, 513–516.

Much of the confusion in the results of and indications for radiation therapy in cancer of the breast is due to a lack of an acceptable classification, based on various stages of the disease, and both clinical and pathological involvement. The criteria for prognosis, operability, and curability vary so widely that it is believed a classification based on clinical and pathological evidences of involvement would permit comparison of the results of surgery, radiation therapy, and other therapeutic procedures. A classification for cancer of the breast was first published by the author in 1937, with three groups. This was revised to include a fourth group as follows:

Group or Stage 1
- Skin: not involved
- Tumor: localized in breast and movable
- Metastases: no axillary lymph nodes involved; no other metastases.

Group or Stage 2
- Skin: not involved
- Tumor: localized in breast and movable
- Metastases: few positive axillary lymph nodes only.

Group or Stage 3
- Skin: edematous, brawny red induration or inflammation obviously not due to infection, extensive ulceration, multiple secondary nodules.
- Tumor: diffusely infiltrating breast, fixation of

tumor or breast to chest wall, edema of breast, secondary tumors.

Metastases: many axillary lymph nodes involved or fixed, no evidence of remote metastases.

Group or Stage 4

Skin: as in any other group or stage

Tumor: as in any other group or stage

Metastases: extensive involvement of axillary and supraclavicular lymph nodes with evidence of distant metastases.

Preoperative irradiation in Stage 1 and 2 is not indicated. Postoperative irradiation in Stage 1 has not improved the five year survival rate. Patients considered incurable should not undergo surgery, but should have radiation therapy and treatment with endocrine preparations. Androgens are more effective in young women or those with osseous metastases; estrogens, commonly given as diethylstilbestrol, are better in older women. In the author's series 45 per cent of all patients were classed in Stages 3 and 4 when first examined. Such cases are incurable with surgery and the average five year survival rate after operation alone is no greater than if none were performed. Comparison of results of surgery alone for selected early cases with results of irradiation in advanced disease cannot be justified.—*Francis O'Neill, M.D.*

Buckles, Maurice G. The surgical aspects of calcified hilar lymph nodes. *Ann. Surg.*, Nov., 1950, *132*, 972–979.

The author feels that insufficient emphasis has been placed upon the importance of calcified hilar lymph nodes with the resulting clinical manifestations of extrinsic bronchial compression and bronchial erosion; in other words, the importance of their physical presence.

The chief manifestations, as noted by personal observation, have been: (1) partial bronchial obstruction with persistent wheezing; (2) partial or complete bronchial obstruction; (3) bronchial erosion; and (4) endogenous spread of tuberculosis due to the intrabronchial rupture of tuberculous lymph nodes.

The intrabronchial rupture of a caseous lymph node is considered to be one of the main modes of progression of a primary tuberculous process. However, due to the low incidence and the fulminating course when it occurs, it is not a surgical problem. The other manifestations have been noted, and 8 of the more typical examples are presented.

In all cases the patients presented themselves with definite symptoms; in every case evidence was found to substantiate the cause as being due to compression or erosion of a bronchus by calcified hilar lymph nodes.

The chief diagnostic findings were roentgen evidence of isolated lymph nodes which were partially calcified; areas of inflammatory change surrounding the lymph nodes or distal to them; and areas of atelectasis distal to these lymph nodes. Endoscopy was of value in certain cases and is an indispensable diagnostic procedure. Bronchography was perhaps of the greatest value in localizing the process. The differential diagnosis was frequently not possible until an exploratory thoracotomy had been performed; however, an impression can be formed when the mechanism of this condition is borne in mind.

The author feels that in the past little importance has been attached to these lymph nodes. While usually they are clinically benign, they may be causative agents of very serious pulmonary disease. It is felt that they are frequent, and if their clinical significance is appreciated, the importance of their surgical aspect will be apparent. Fortunately, in a high percentage of cases, surgery gives relief of the pulmonary complications.—*C. D. Frey, M.D.*

Felson, Benjamin, and Felson, Henry. Localization of intrathoracic lesions by means of the posteroanterior roentgenogram: the silhouette sign. *Radiology*, Sept., 1950, *55*, 363–374.

A method of localizing intrathoracic lesions from the posteroanterior roentgenogram of the chest is described. An intrathoracic lesion anatomically contiguous with the border of the heart and aorta will obliterate that border. The observed obliteration of the cardiovascular border has been termed the *silhouette sign*. A lesion not contiguous with a border of the heart or aorta will not obliterate the border.

Since the heart is located anteriorly in the chest, a positive silhouette sign or obliteration of the cardiac border indicates the diseased area of the lung also is located anteriorly. If the cardiac border is not obliterated by the overlying diseased area, the area is located posteriorly. Since the aorta lies posteriorly, a silhouette sign of the aorta indicates that a contiguous lung lesion lies posteriorly and the absence of the sign, that the lesion lies anteriorly.

It is necessary that the technical quality of the roentgenogram be such that the diseased area is adequately penetrated. The outline of the cardiovascular structure must be clearly visible beyond the shadow of the spine. The abnormal density must either overlap or be contiguous with a portion of the cardiovascular border. The diseased area contiguous with the cardiovascular margin must be completely airless.

This method of localization has been found very accurate in over 84 intrathoracic diseases including collapse of a lobe or segment, and in other radiopaque shadows whether pulmonary, pleural or mediastinal in origin.

The applications and limitations are described. Thirteen excellent roentgenograms demonstrating

the silhouette sign are presented.—*E. E. Seedorf, M.D.*

RILEY, EDGAR ALSOP. Boeck's sarcoid; a review based upon a clinical study of fifty-two cases. *Am. Rev. Tuberc.*, Sept., 1950, *62*, 231–285.

The authors have reviewed a series of 52 cases of Boeck's sarcoid seen at Bellevue Hospital between 1939–1949. The average follow-up was four years eight months, with the maximum follow-up being nineteen years. This review contributes greatly to the literature on the subject since it includes such a long list of well studied cases. In addition to the summary of these cases, a historical background as well as a review of the pathological findings is set forth. The disease, in this series, shows a definite predilection for young adults of the Negro race. No direct evidence has been elicited to prove the cause of Boeck's sarcoid to be the tubercle bacillus, although it is clearly shown that there is a close relationship between sarcoid and tuberculosis. The etiology of sarcoid has not been proved as yet, and this subject warrants further study in the future.

In many previous clinical reports the benign nature of sarcoid has been overemphasized. One of the most striking features this study reveals is the complete lack of correlation between the severity and extent of the pathological change and the symptoms related to the disease. The majority of complaints registered in this series are related to the chest. Ten patients complained of hemoptysis, which was probably due to bronchiectasis occurring secondary to the primary sarcoid involvement of the lungs. Weight loss was noted in over half of the cases reported. Fever was the subjective complaint registered by 6 of these patients, although 50 per cent encountered fever during some stage of their illness. Wheezing was also noted in 6 cases of the 52. Many miscellaneous complaints were registered, including abdominal pain, nausea and hoarseness. The majority of these symptoms were explainable by local pressure resulting from regional lymph adenopathy.

The most common clinical finding was lymph adenopathy. The enlarged lymph nodes were firm, discrete and usually not tender; they were peripheral or central in location. Pulmonary involvement was noted in 87 per cent, while splenomegaly and hepatomegaly were the next most common features of the disease. Involvement of the uveal body was found in 29 per cent.

The clinical laboratory features of sarcoidosis were not prominent, although the failure to react to tuberculin is probably noteworthy in that 65 per cent of these cases were non-reactors.

The roentgenologic features of the disease are related to the osseous changes, and changes involving the lung fields and mediastinal glands. The osseous changes have a predilection for the phalanges and are of two types: discrete punched out areas, or more frequently peculiar lattice-like alteration of the trabecular pattern described in numerous articles. These changes may simulate those of leprosy but the sensory involvement of leprosy is conspicuously absent.

The roentgenological changes of the chest may be limited to the mediastinal lymph nodes as reported in 6 of the 52 cases. However, the more frequent finding is that of a fan-like radiation into the lung field from the hilus, invariably accompanied by marked hilar lymphadenopathy. This type of pulmonary change was noted in 31 per cent of the cases. Very small discrete nodular areas scattered throughout both lung fields were found in 20 per cent of the cases. These nodules were frequently larger and coarser than those seen in miliary tuberculosis. In the nodular type, mediastinal lymphadenopathy was usually not prominent. A small number of the cases reported showed all the known changes of the lungs, and mediastinum. A correlation between roentgen findings in the lungs and biopsy findings is not possible due to the fact that those who die succumb either to extensive tuberculosis or to right heart failure secondary to pulmonary fibrosis, and these extreme cases are not reported very frequently. The reversibility of the roentgen findings in the chest is considered to represent the ability of the sarcoid tubercle to resolve completely.

The course of sarcoid is usually chronic and prolonged, extending over a period of years. The onset of symptoms is insidious and gradual. Complications may include spontaneous pneumothorax occasioned by a ruptured subpleural bleb or infrequently due to a penetrating peripheral tubercle. Cor pulmonale may supervene due to encroachment on the pulmonary vascular bed. More serious complications involve the eye with formation of synechiae, corneal opacities or phthisis bulbi. The development of active tuberculosis has also long been recognized as one of the common complications of sarcoidosis. In this series, 25 per cent of the patients subsequently developed active tuberculosis. In those cases developing this latter complication, the tuberculosis encountered was of a severe nature and a rapidly retrogressive course usually ensued.

The treatment of Boeck's sarcoid has been very unrewarding. Chemotherapeutic drugs have been disappointing and bed rest does not seem to be important in delaying the progress of the disease or of preventing complications. Roentgen therapy to the areas of pulmonary involvement and lymph node enlargement has been found to be of no value.

In this series the related mortality was reported to be almost 20 per cent; an additional 13 per cent of the patients developed active tuberculosis during the follow-up. The above figures do not include the high percentage of patients with irreversible pulmonary and ocular damage. The term "benign lymphogranulomatosis," according to the experience of the authors, is misleading and should probably be abandoned.—*W. A. Klauber, M.D.*

Lees, A. W. Atelectasis and bronchiectasis in pertussis. *Brit. M. J.*, Nov. 18, 1950, *2*, 1138–1141.

Atelectasis was noted roentgenologically in 43 per cent of 150 pertussis cases, but in general it was slight in extent and of comparatively short duration. It occurred with increasing frequency until the fourth week of illness; then its incidence declined. Duration was seldom longer than five weeks. Six instances of virtually complete lobar collapse took longer than two months to resolve; in 5 of these, bronchial dilatation was demonstrated but reverted to normal when the lobes were re-expanded. In only 1 case did respiratory symptoms persist.

Bronchopneumonia was detected roentgenologically and clinically in 20 per cent of all cases. Atelectasis occurred in 40 per cent of these cases; in those without bronchopneumonia, the incidence was 44 per cent.

Slight enlargement of hilar lymph glands was demonstrated roentgenologically in 18.7 per cent of pertussis cases.

The pathogenesis and treatment of atelectatic bronchiectasis in pertussis is discussed and a trial of artificial pneumothorax mentioned.—*J. D. Reeves, M.D.*

Martin, Hayes, Morfit, H. Mason, and Ehrlich, Harry. The case for branchiogenic cancer (malignant branchioma). *Ann. Surg.*, Nov., 1950, *132*, 867–887.

The authors have critically reviewed the literature on the general subject of branchiogenic cancer and have included in their article 15 cases of their own and 3 cases reported by Oliver.

They define a branchiogenic cancer as a malignant tumor arising from a vestigial remnant of a branchial pouch and have listed their criteria for the tentative diagnosis of branchiogenic cancer as follows:

(1) The cervical tumor must have occurred somewhere along a line extending from a point just anterior to the tragus of the ear, downward along the anterior border of the sternomastoid muscle to the clavicle.

(2) The histopathologic appearance of the growth must be consistent with an origin from tissue known to be present in branchial vestigia.

(3) The patient must have survived and have been followed by periodic examination for at least five years without the development of any other lesion which could possibly have been the primary tumor.

(4) The best criterion of all would be the histopathologic demonstration of a cancer developing in the wall of an epithelial-lined cyst situated in the lateral aspect of the neck.

The authors discuss thoroughly the embryonal developmental anatomy of the branchial apparatus, the histopathology of the region, and deal at length with the etiology, symptomatology and clinical course in 15 cases of cervical carcinoma without any other demonstrable primary tumor that have survived five years following treatment.

The authors conclude that in all of the 18 cases (including 3 cases of Oliver's) which they have reviewed, and which have met with the above criteria, the evidence of such an origin (branchiogenic cancer) remains unproved.

They do not deny the possibility of the existence of such a tumor, but caution against its diagnosis unless the rigid criteria listed above are fulfilled. The importance of the subject lies in the frequency with which the diagnosis of branchiogenic cancer is unjustifiably made in cases where the patient complains only of a cervical mass and in which no other focus of growth is discovered immediately or even by repeated examinations. Such a diagnosis precludes that treatment will then be given only to the cervical mass and that no further search for a primary lesion will be made.

The authors discuss at length the case for the existence of branchiogenic cancer. In all of the cases that have appeared in the literature, including the cases discussed in their article, even though they have fulfilled the criteria listed by the authors, there is no positive evidence that a tumor of branchiogenic origin existed in any of them. In all the cases (except 1 of the authors' cases in which the histopathologic and surgical findings could not exclude origin from the tail of the parotid gland, and in which surgery alone was employed) a cancer lethal dose of radiation was employed which may have caused disappearance of the primary lesion.

The authors conclude that the existence of a clinical entity deserving the term branchiogenic cancer is entirely hypothetical. They further conclude that there may be no more reasonable explanation for the origin of certain rare cervical tumors. They state that the diagnosis of branchiogenic cancer should always remain tentative and should never be considered unless the patient has survived five years without discovery of any other primary tumor. A systemic plan for management of these selected cases of cervical carcinomatous tumors is presented and the original article should be consulted.—*R. B. Jeffrey, M.D.*

Schneider, Louis. Upper lobe bronchial abnormalities simulating significant pulmonary tuberculosis: with seven illustrative cases. *Radiology*, Sept., 1950, *55*, 390–397.

The purpose of this paper is to differentiate between tuberculosis and bronchiectasis involving the upper lobes of the lungs. Bronchiectasis is predominantly a disease of the lower lobes, but numerous subclinical, mild and dry types have been found involving the upper lobes exclusively. In the author's experience the right upper lobe is most often involved.

After failure to confirm pulmonary tuberculosis by

a positive tuberculin test or sputum test, the diagnosis of upper lobe bronchiectasis is established by noting the honeycombing fibrosis on the roentgenogram, then by confirming dilatation of the upper bronchial tree as outlined with iodized oil in bronchography.—*E. E. Seedorf, M.D.*

WHITESIDE, J. H. Hamartoma of the lung. *Canad. M.A.J.*, Oct., 1950, *63*, 383–384.

The differential diagnosis involved in solitary discrete pulmonary nodules concerns tuberculoma, parasitic cysts, primary or secondary malignant tumor and benign tumor. A case is reported of a clear cut rounded density in the lung base, located laterally. The gross specimen was that of a firm, white, egg-shaped nodule, loosely embedded, close to the pleural surface. The cut surface was composed of islands of pearly white tissue of cartilaginous consistency, separated by pinkish white fibrous tissue. Histopathological examination revealed the presence of masses of hyaline cartilage, fibrous tissue stroma, and clefts lined by cuboidal epithelium. In the fibrous tissue were mingled fat cells, lymphocytes, myxomatous connective tissue and smooth muscle fibers.

Hamartoma is a term used to describe tumor-like growths resulting from a faulty mixture of the normal components of an organ.

Hamartomas of the lung are benign, usually symptomless tumors, ordinarily not roentgenologically characteristic. They are usually near the periphery and less than 3 cm. in diameter, sharply demarcated, and frequently exhibit a lobulated shadow. The histopathologic picture is more conclusive, showing only the elements found in the normal bronchus, but with an abnormality of the quantity and arrangement of the various components. Since they are not found in the mediastinum and contain only bronchial elements, they should not be considered as teratomas.—*C. N. Borman, M.D.*

LEMON, WILLIS E., and GOOD, C. ALLEN. Hamartoma of the lung; the improbability of preoperative diagnosis. *Radiology*, Nov., 1950, *55*, 692–699.

For some time the roentgenologic appearance of a hamartoma of the lung was thought to be somewhat characteristic. The tumor was usually reported to be dense, fairly sharply demarcated and to contain small scattered calcifications. Lemon and Good, however, were impressed with the lack of characteristic findings and therefore thoroughly reviewed 17 proved cases of hamartoma seen in their institution. Seven of the 17 (41 per cent) did not have any calcification. In only 5 of this series was the calcification sufficiently similar to the reported classical type to enable the roentgenologist to consider hamartoma.

There were about twice as many males as females in this series but there were no characteristic symptoms or signs. Bronchoscopy and cytologic studies of the sputum did not offer any help. It is apparent that the diagnosis of this type of tumor cannot be made except on microscopic examination of the excised specimen.—*C. A. Stevenson, M.D.*

FARBER, SEYMOUR M., MCGRATH, ALLEN K., JR., BENIOFF, MORTIMER A., and ROSENTHAL, MILTON. Evaluation of cytologic diagnosis of lung cancer. *J.A.M.A.*, Sept. 2, 1950, *144*, 1–4.

In the past four years the authors have studied sputum and bronchial secretions from 2,066 patients. The Papanicolaou and Traut technique was used. In 6,281 specimens (208 patients had both bronchoscopically aspirated specimens and sputum and many patients had multiple sputum samples) a total of 176 patients were reported with definite malignancy and 25 as suspicious for malignancy. Proof of cancer was obtained in 125 of these 201 patients. Fifty patients had bronchogenic carcinoma and 22 had metastatic carcinoma. Undifferentiated cancers were detected only half as frequently as well differentiated ones because it is difficult to distinguish a small undifferentiated carcinoma cell from "small round cells." Thirty-six of 60 patients with peripheral tumors had positive smears and although 49 of this group had been bronchoscoped nothing was seen at endoscopy. Five sputum examinations and any bronchoscopically aspirated specimens available constitute the minimal desirable evidence. A negative cytologic diagnosis must be carefully evaluated. Extensive experience is the most important single factor in cytologic diagnosis.—*John Turner, M.D.*

DOLL, RICHARD, and HILL, A. BRADFORD. Smoking and carcinoma of the lung; preliminary report. *Brit. M.J.*, Sept. 30, 1950, *2*, 739–748.

After an exhaustive and detailed statistical study, the authors conclude that smoking is an important factor in the cause of carcinoma of the lung. They suggest that above the age of forty-five the risk of developing the disease increases in simple proportion with the amount smoked and that it may be approximately 50 times as great among those who smoked 25 or more cigarettes a day as among non-smokers.

The material for the survey was obtained from twenty hospitals in the London region. Comparative studies were made of patients with carcinoma of the stomach and large bowel and of a control group of non-cancer patients of the same sex and age distribution.

The series consisted of 649 men and 60 women with carcinoma of the lung. Of the men, 0.3 per cent and of the women, 31.7 per cent were non-smokers.

Corresponding figures for the non-cancer control groups were: men, 4.2 per cent and women, 53.3 per cent.—*J. N. Ané, M.D.*

Romagosa, J. J., Menville, L. J., and Leckert, J. T. Radiographic changes in the lungs during recovery from drowning. *Radiology*, Oct., 1950, *55*, 517–521.

The roentgenographic and clinical findings are presented in a patient who was removed from a pool of water in an unconscious condition, was revived with artificial respiration, suction, and oxygen, and who fully recovered.

A chest roentgenogram thirty-six hours after resuscitation showed obscuration of the cardiophrenic angles and mottled opacities, with areas of confluence in the inner two-thirds of the lung fields. Subsequent roentgenograms on following days showed progressive clearing. A roentgenogram made thirty-six hours after immersion and one three weeks later are presented.

The lung changes are believed to be due primarily to pulmonary edema.

A discussion of studies made on animals drowned in salt water, chlorinated water and fresh water is presented.—*E. E. Seedorf, M.D.*

Morton, Douglas R., Klassen, Karl P., and Baxter, Earl H. Lobar agenesis of the lung. *J. Thoracic Surg.*, Oct., 1950, *20*, 665–670.

The classification of agenesis of the lung was first made by Schneider in 1912. Since that time the following definitions ordinarily have been employed as a basis for nomenclature:

Agenesis of lung: where there is complete absence of the lung and bronchi.

Aplasia of lung: where there is a rudimentary bronchus but no pulmonary alveolar tissue.

Hypoplasia of lung: where pulmonary tissue is underdeveloped in an entire or in part of a lung.

Agenesis of the lung is a rare congenital anomaly. However, lobar agenesis of one lung associated with an anatomic developmental abnormality of the bronchus is so exceptionally rare that it is not specifically mentioned in the literature.

The authors report 2 similar cases of agenesis of the right upper and middle lobes. The roentgenograms on both cases and a bronchogram on one of the cases are reproduced. The roentgenograms show changes similar to those seen in hypoplasia of the lung.—*T. C. Stansbury, Jr., M.D.*

Prior, John A., Wilce, John W., and Palchanis, William. Geographic distribution of pulmonary calcification among university students in Ohio. *Pub. Health Rep.*, Sept. 1, 1950, *65*, 1132–1138.

A study on Ohio students was carried out by means of chest roentgenograms, tuberculin and histoplasmin tests. It was demonstrated that there is a definite geographical pattern of incidence of pulmonary calcification occurring across the state and that this pattern closely parallels a similar pattern for the prevalence of histoplasmin reactors. The major number appears in the Southwest with the percentage lessening as the Northeast corner of the state is reached. The tuberculin reactors were scattered without pattern over the state. It was further noted that pulmonary calcification in Ohio is more commonly associated with histoplasmin sensitivity than with tuberculin sensitivity.—*G. H. Ramsey, M.D.*

Bloom, Joseph, and Rubin, Jack H. Transient pulmonary manifestations in rheumatoid arthritis. *Canad. M.A.J.*, Oct., 1950, *63*, 355–357.

Pulmonary reticulations simulating miliary tuberculosis or Boeck's sarcoidosis have been reported previously in 4 cases of rheumatoid arthritis. The authors present what they consider as an additional case. The development of widespread mottling and infiltration throughout both lungs was intimately associated with systemic manifestations by rheumatoid arthritis. Serial film studies at monthly intervals showed gradual disappearance of the lung lesions, while the systemic arthritic symptoms likewise disappeared. Tuberculosis and Boeck's sarcoidosis were eliminated from diagnostic consideration by all the routine laboratory procedures, as well as by prolonged clinical observation. The authors suggest anaphylaxis as the best explanation of the mechanism of production of the lung lesions.

The lung lesions found on autopsy in 2 of the earlier reported cases are said to resemble the lung lesions produced in animals rendered anaphylactic with horse serum or egg albumin.—*C. N. Borman, M.D.*

Potts, Willis J., and Riker, William L. Differentiation of congenital cysts of the lung and those following staphylococcic pneumonia. *Arch. Surg.*, Oct., 1950, *61*, 684–695.

Differentiation of a true lung cyst from the acquired type is of primary importance because the former will not disappear spontaneously while the latter may.

It is now generally accepted that congenital lung cysts are formed during embryonic development. It is surmised that during development of the bronchial buds, intermediate portions of the lumens may be blocked off, allowing peripheral formation of cystic cavities lined with bronchial type of epithelium and filled with secretions. When the obstructed bronchial lumen is forced open, the fluid may be evacuated and be replaced by air. If the bronchial opening is large, the cyst remains the

same size. If it is narrow and tortuous, a check-valve mechanism may allow the cyst to balloon up under tension.

The writers have been impressed with the frequency of acquired cysts of the lung (pneumatoceles) occurring during the course of staphylococcic pneumonia in infancy. Initial roentgen examination usually shows the consolidation stage of the disease. Repeated roentgenograms during the illness will often reveal discrete, round radiolucent areas in the consolidated lung parenchyma. Empyema or pneumothorax frequently follows. Tension pneumothorax may follow rupture of a cyst or bleb and require emergency aspiration and closed drainage.

In staphylococcic pneumonia, peribronchial consolidation is usually followed by suppuration in the form of multiple tiny abscess cavities. Such cavities may break into the pleural cavity and form empyema. If such an abscess is connected with an open bronchus and ruptures into the pleural cavity, a pyopneumothorax will result. If an abscess in the lung breaks into and evacuates through a bronchus, a small air-containing cavity may result. The small inflamed bronchus entering this cavity may allow entry of air but not egress because of the check-valve mechanism formed by the combination of bronchial occlusion from edema and normal expiratory constriction of the bronchus. Gradually the cavity may enlarge, displacing the adjacent lung. Such cyst-like spaces may remain for long periods after the infant has recovered from pneumonia. They may fluctuate in size, occasionally ballooning up to alarming proportions. Suddenly the pneumatocele may disappear entirely because of loss of the valvular mechanism in the bronchus and re-expansion of the surrounding lung. They rarely become infected.

The writers present 6 cases of congenital lung cyst. One case was that of a five day old infant treated by lobectomy, with recovery.

Nine cases of staphylococcic pneumonia are reported in which, at some time during the illness or thereafter, the condition simulated a lung cyst.

Differential diagnosis of congenital and acquired post-infection cysts of the lung in infants is discussed by the writers.

The history is most important. If a child has had proved staphylococcic pneumonia or if there is a history of severe respiratory illness, a radiolucent area in the lungs is most likely an acquired cyst. During infancy congenital cysts are rarely infected.

Congenital cysts usually maintain a rather constant size while pneumatoceles may fluctuate in size rapidly.

Congenital cysts may show thicker walls roentgenographically than acquired cysts.

Infection in the congenital cyst becomes a more frequent occurrence as the child gets older, but it is rare in the pneumatocele.

Congenital cysts of the lung should be treated by excision of the involved lung tissue as early as is feasible. Acquired "cysts" should be observed, since a majority disappear spontaneously. If any treatment is required, it may be conservative.—*R. F. Niehaus, M.D.*

HARPER, FRED R., CONDON, WILLIAM B., and WIERMAN, WILLIAM H. Middle lobe syndrome. *Arch. Surg.*, Oct., 1950, *61*, 696–704.

Chronic nonspecific pneumonitis with atelectasis occurring in the middle lobe of the right lung has recently been classified as a clinical entity. Graham, Burford, Mayer, and others, including the present writers, refer to this lesion as "middle lobe syndrome." They have mentioned that enlargement of peribronchial lymph nodes has been common in their cases.

The writers of the present article have reviewed their cases of chronic suppurative pulmonary disease. They were unable to find a correlated clinical and pathologic entity peculiar to the middle lobe. They did, however, find 26 patients in whom they felt that involvement of hilar lymph nodes was directly responsible for the obstruction that resulted in chronic nonspecific pneumonitis. Only 8 of the 26 patients could be classified as having the "middle lobe syndrome." There were 3 additional patients with the same clinical roentgenologic and laboratory findings as the others but in whom a diagnosis of tuberculosis was made by the pathologist. In another 6 patients the middle lobe was primarily involved with nonspecific pneumonitis but, in addition, a segment of either the upper or the lower lobe of the right lung was also involved. In still another group of 9 patients the same lesion was found, but the pathologic condition was located in the upper or the lower lobe of the left lung.

In all the 8 patients in whom the disease was confined to the middle lobe, calcified lymph nodes in the region of the middle lobe bronchus was the common roentgenologic finding. This was also true of the patients with nonspecific pneumonitis in segments of other lobes.

Chronic inflammation and calcification of the hilar lymph nodes was the most striking finding in cases of chronic pneumonitis and obstructive atelectasis. The middle lobe was involved more frequently because of its anatomic peculiarities. However, other lobes may be similarly involved, particularly the upper lobe of the left lung.

The writers believe that the chronic pneumonitis is a result of obstruction, with resulting infection. The obstruction is brought about by lymph node involvement, either from pressure alone or from pressure and stenosis of the bronchial wall. While most of the patients in the writers' series had no demonstrable tuberculosis, they still believe that tuberculosis contracted and healed years before might well have been responsible for the subsequent bronchial occlusion and resulting pneumonitis.

According to the writers, the roentgen findings in

this type of pneumonitis are indistinguishable from the findings in bronchogenic carcinoma. Also the symptoms are identical in that hemoptysis, cough and pain are prominent features, whether the lesion is malignant or inflammatory. Resection of the lung is the treatment indicated because the inflammatory process is not reversible.—*R. F. Niehaus, M.D.*

Nicholson, Howard. Suppurative pneumonia. *Lancet*, Nov. 18, 1950, *2*, 549–554; Nov. 25, 1950, *2*, 605–611.

This article deals in detail with the problem of lung suppuration. Reproductions of roentgenograms and case histories are used profusely.

The first part of the paper discusses the specific pneumonias as a cause for lung abscess but particular emphasis is devoted to cases of lung suppuration caused by nonspecific organisms, many of which are found in the upper respiratory tract. The author regards lung abscess as the most severe variety of a whole range of aspiration pneumonias; at the opposite extreme are those benign localized pneumonias associated with upper respiratory infections. To support this view he reviews some of the evidence that infected material may be aspirated into the bronchial tree and produce pulmonary changes, and he gives examples of aspiration pneumonias of varying severity.

The classification of abscesses into fetid and nonfetid types is not important as far as treatment and prognosis is concerned.

The second part of the paper is concerned with the subject of nonspecific suppurative pneumonias. This phase of chronic suppuration of the lung has been given many names such as aputrid abscess, necrosuppurative pneumonia and spreading pneumonitis. The author prefers the term chronic nonspecific suppurative pneumonia. The condition is characterized by the long standing production of purulent sputum which has a mixed and often varying flora; and in the lungs areas of pneumonic consolidation are found, often associated with abscess cavities.

Again the varying manifestations of the disease are discussed by means of many case reports and roentgenograms.

The treatment ranges from postural drainage and antibiotics to lobectomy.

This is a very exhaustive article on the subject of chronic pneumonias and the original article should be studied by those interested in the disease.—*J. H. Harris, M.D.*

Berg, Ralph, Jr., and Burford, Thomas H. Pulmonary paraffinoma (lipoid pneumonia); a critical study. *J. Thoracic Surg.*, Sept., 1950, *20*, 418–428.

The authors define pulmonary paraffinoma as an advanced lipoid pneumonia due to mineral oil. Six cases of pulmonary paraffinoma are presented.

The lesion is often interpreted as a primary or metastatic tumor clinically, roentgenologically, at operation and even on frozen section.

Clinically the patient is usually an adult who may have no symptoms or has minimal symptoms in comparison to the striking gross roentgen findings. A history of the use of mineral oil can usually be obtained. There may or may not be an associated neurologic lesion resulting in impairment of ability to swallow or mechanical interference with deglutition as with diverticula and cardiospasm.

Roentgenographically a pulmonary paraffinoma appears as a rather homogeneous shadow with sharply defined peripheral limits and a feathering of density at its hilar aspect. The authors have never seen hilar adenopathy with the lesion. The lesion is located in recognized aspiration sites in greatest frequency. They are often multiple and may be bilateral.—*T. C. Stansbury, Jr., M.D.*

Nataro, Maurice, Shapiro, David, and Gordon, Armond T. Acute primary Klebsiella pneumonia. *J.A.M.A.*, Sept. 2, 1950, *144*, 12–16.

The authors review recent medical literature dealing with lobar pneumonia caused by the gram-negative bacillus of the Friedländer group, *Klebsiella pneumoniae*. Although this group accounts for only 0.5 to 1.6 per cent of all cases of pneumonia, it has remained important because of the frequently fatal outcome. As late as 1945, reports indicated mortality rates of 51 to 97 per cent.

Five cases of lobar pneumonia due to *Klebsiella pneumoniae* are reported. It is suggested that the radiologist may be of definite aid if all cases in which there is massive, dense and usually homogeneous lobar consolidation are suspected and studied for etiology by laboratory examinations, of blood and sputum. Marked bulging of the consolidated areas at fissures is a suggestive sign of this type of pneumonia.

Penicillin and sulfonamide drugs have proved to be ineffective, but the authors had excellent response in 4 patients treated with streptomycin and in 1 treated by aureomycin hydrochloride. There was no instance of abscess formation or fibrosis which have been common in earlier reported series of acute primary *Klebsiella* pneumonia.—*John Turner, M.D.*

Read, C. Thomas, and Berry, F. B. The utilization of streptokinase-streptodornase in a patient with hemopneumothorax and a patient with postpneumonectomy sanguineous coagulum. *J. Thoracic Surg.*, Sept., 1950, *20*, 384–392.

The rapid lysis of blood clots and related coagulum of exudate takes place when concentrated and partially purified preparations derived from broth

cultures of hemolytic streptococci are instilled into them. These preparations are unique in their action in that they show rapid lysis of fibrin clots, alter fibrinogen so that it no longer forms fibrin and cause the insoluble fibrous-like nucleoprotein found in purulent collections to dissolve. The streptococcal fibrinolysin product has been termed "streptokinase" and the nucleoprotein lysing factor "streptodornase."

Streptokinase acts very much like a catalyst but is depleted as the dissolution of the parent substance takes place, consequently its action in patients is self terminating.

The successful use of streptokinase-streptodornase in a patient with a hemopneumothorax and a patient with postpneumonectomy sanguineous coagulum is reported.—*T. C. Stansbury, Jr., M.D.*

SHERRY, SOL, TILLETT, WILLIAM S., and READ, C. THOMAS. The use of streptokinase-streptodornase in the treatment of hemothorax. *J. Thoracic Surg.*, Sept., 1950, *20*, 393–417.

This article consists of a detailed report of the procedures used and the results obtained following the intrathoracic injections of partially purified streptococcal concentrates containing streptokinase and streptodornase into patients with massive hemothorax. Details of the mechanism of the action of the streptococcal fibrinolytic principle are reviewed and the practical aspects of its use are described at considerable length.

The first 27 cases of hemothorax, treated with streptococcal enzymes by the authors constitute the substance of this report. They are divided as follows:

1. Sterile postpneumonectomy hemothorax—10 cases.
2. Infected postpneumonectomy hemothorax—4 cases.
3. Sterile hemothorax traumatic, with lung in situ—11 cases.
4. Infected hemothorax, traumatic with lung in situ—2 cases.

1. In 10 patients with massive sterile postpneumonectomy hemothorax, the injection of solutions of streptokinase-streptodornase was uniformly effective in liquefying rapidly the intrathoracic coagulum and affording its removal by aspiration.

2. Four patients with infection contained within the postpneumonectomy hemothorax were treated successfully in a similar manner, appropriately supplemented by the use of antibiotic reagents.

3. Eleven patients with traumatic hemothorax (bullet wound, stab wound, fractured ribs, and postoperative) with lungs in situ, have been treated by injections of the enzymes, often introduced simultaneously into multiple sites. In 9 of the patients fibrinolysis was followed by a marked increase in the amount of sanguineous fluid removed by aspiration and extensive clearing of the pleural area.

4. In 2 patients with infected traumatic hemothorax an intractable state was rapidly and favorably altered by the use of streptokinase-streptodornase and was followed by recovery.—*T. C. Stansbury, Jr., M.D.*

LOWEN, HARRY J., FINK, SEYMOUR A., and HELPERN, MILTON. Transfixion of the heart by embedded ice pick blade with eight months' survival. *Circulation*, Sept., 1950, *2*, 426–433.

The authors found many cases of penetrating wounds of the heart reported in the literature, but only a very few who had electrocardiographic findings and fewer still which involved only the auricles.

In this paper they present an unusual case admitted to the Harlem Hospital, who, on subsequent examinations was found to have an 8 cm. long ice pick blade embedded in the sixth dorsal vertebra transfixing the left auricle and penetrating the mitral valve.

History revealed that the foreign body had been present six months without any real difficulty other than increasing dyspnea. At the time of admission, his chief complaints were dysuria, chills, fever, and pain in the left costovertebral angle.

Complete physical, cardiographic, roentgenographic, operative and necropsy findings are presented in detail.

In general discussion, the authors state that the indications for removal of a foreign body from the heart are as follows: (1) to prevent embolism of the foreign body, or the development of thrombosis and subsequent embolization, (2) to reduce the danger of bacterial endocarditis, (3) to prevent recurrence of pericardial effusions, and (4) to reduce incidence of myocardial damage.

They feel that the cardiographic findings are due to one or more of the following factors: (1) myocardial damage by the foreign body, (2) pericarditis, (3) injury to an important branch of a coronary artery.

In this particular case the difficulties were thought to be due to development of a vegetative endocarditis and multiple embolization.—*E. K. Rose, M.D.*

ANGELMAN, HARRY, HALL, E. G., and SPENCER, R. The syndrome of obstruction of inferior vena cava in childhood. *Brit. M. J.*, Sept. 30, 1950, *2*, 752–755.

Three cases of obstruction of the inferior vena cava in childhood are reported. Several other cases from the literature are reviewed briefly. One of the 3 cases showed marked renal involvement. This case at necropsy showed involvement of the entire vena cava and the thrombosis extended into the pulmonary arteries. One case had venograms and this showed evidence of involvement of the left femoral and iliac vein. No definite etiology was discovered. Two of these cases are living fairly normal lives.

Some of the cases in the literature live relatively active lives; such obstruction is not necessarily fatal.—*E. C. Baker, M.D.*

Wood, Paul. Congenital heart disease; a review of its clinical aspects in the light of experience gained by means of modern techniques. Part I. *Brit. M. J.*, Sept. 16, 1950, *2*, 639–645.

This report is based on 233 cases, 200 of which were proved to be congenital lesions by the author's techniques of cardiac catheterization and angiocardiography. He describes his catheterization methods in some detail. In his series he found the incidence of:

Fallot's tetralogy—18%
Atrial septal defect—17%
Patent ductus—14.5%
Ventricular septal defect—12%
Simple pulmonary stenosis—11.5%
Coarctation of the aorta—8%

Together these six conditions account for 81 per cent of congenital lesions.

Ten major items considered in the clinical diagnosis were: (1) concurrent other congenital anomalies; (2) effort tolerance; (3) cyanosis; (4) pulse and pulse pressure; (5) jugular venous pressure; (6) cardiac pulsations; (7) second heart sound; (8) electrocardiogram; (9) murmurs and thrills; (10) roentgen appearance. Coarctation of the aorta, patent ductus arteriosus and ventricular septal defect are discussed in respect to these items.

A differential diagnosis between patent ductus arteriosus and (1) perforation of an aortic sinus into the pulmonary artery, and (2) perforated aortic sinus into the right ventricle, (3) arteriovenous aneurysm, (4) rheumatic aortic incompetence and mitral stenosis, and (5) ventricular septal defect with aortic incompetence is given. The author states that in cases of patent ductus with pulmonary hypertension the prognosis must be guarded because it may be irreversible. Of his 29 cases of patent ductus 21 were females and 8 males. There was no difference in the incidence of coarctation and ventricular septal defect in males and females.

A differential diagnosis between ventricular septal defect and (1) pulmonary valvular stenosis, (2) mitral incompetence, (3) patent ductus, and (4) atrial septal defect is given. This is an excellent review of the clinical aspects of these anomalies and the article must be read in full to obtain the detailed information.—*F. M. Windrow, M.D.*

Wood, Paul. Congenital heart disease; a review of its clinical aspects in the light of experience gained by means of modern techniques. Part II. *Brit. M. J.*, Sept. 23, 1950, *2*, 693–698.

Thirty-five patients with atrial septal defect were examined, 25 by cardiac catheterization. The usual physical, electrocardiographic and roentgen findings are discussed. The pulmonary resistance is usually low and the pulmonary blood flow is approximately three times as great as the systemic flow. The pressure in the right atrium is not elevated. Pulmonary hypertension is rare but if it is present it may cause a reversal of the blood flow in the shunt. Differential diagnosis includes the following lesions: pulmonary hypertension with cor pulmonale, ventricular septal defect, idiopathic pulmonary artery dilatation, pulmonary stenosis with dilatation, and normal heart with prominent pulmonary artery from rotation caused by scoliosis.

Pulmonary stenosis is discussed in detail with reference to (1) pulmonary valvular stenosis with closed septa, (2) severe pulmonary stenosis with reversed interatrial shunt, (3) mild valvular pulmonary stenosis with closed septa, (4) pulmonary stenosis with poststenotic dilatation, (5) pulmonary stenosis with ventricular septal defect or atrial septal defect, (6) subvalvular stenosis, and (7) pulmonary stenosis with patent foramen ovale. Sixty-one cases were found in this series of 200 cases of congenital heart lesions; 33 of these were associated with Fallot's tetralogy. Pulmonary stenosis is much more common than previously suspected.—*F. M. Windrow, M.D.*

Gefter, William I., Boucot, Katharine R., and Marshall, E. Wayne. Localized interlobar effusion in congestive heart failure. *Circulation*, Sept., 1950, *2*, 336–343.

A localized transudative interlobar pleural fluid collection in congestive heart failure may well be called a vanishing tumor of the lung. Its name is derived from the frequent resemblance to a pulmonary tumor on a roentgenogram and from its tendency to disappear following fluid mobilization and effective diuresis.

Four cases are presented with accompanying roentgenograms, and previous literature is reviewed. The condition is apparently not as rare as the literature would suggest.

Hydrothorax in congestive heart failure is predominantly right sided and the majority of vanishing tumors of the lung are also right sided. The transverse fissure between the right upper and middle lobes was included in every case reviewed.

The diagnosis is best made by fluoroscopy or by use of the roentgenogram. The usual appearance is that of a well defined homogeneous density in the right lung, occupying especially the transverse, but occasionally the oblique interlobar fissures.

On the film the shadow may assume round, oval, spindle, semilunar, wedge or linear shapes depending upon the volume and position of the fluid, the projection angle and the amount of surrounding pulmonary compression. The anteroposterior view is best for observing fluid in the transverse fissure, but fluid

in the oblique fissure is best visualized in the lateral view of the chest.

Ten roentgenograms and one table accompany the article.—*E. S. Reed, M.D.*

DEROW, HARRY A., MONROE, J. SCHLESINGER, and PERSKY, LESTER. Myasthenia gravis: a clinical and pathological study of a case associated with a primary mediastinal thymoma and a solitary secondary intrapulmonary thymoma. *New England J. Med.*, Sept. 28, 1950, *243*, 478–482.

Tumor of the thymus occurs in approximately a sixth of the patients presenting symptoms of myasthenia gravis. It is usually encapsulated and slowly growing and generally considered benign. It has been called a thymoma. Approximately 10% of such thymomas encroach upon and extend by continuity into the adjacent pleura, lungs, pericardium or superior vena cava. Separate, discrete, secondary deposits of such thymomas occasionally found at a distance on the pleura have been interpreted as implants and not true metastases.

The authors report a case of myasthenia gravis with a large, primary invasive mediastinal thymoma and also a single, separate, discrete, secondary intrapulmonary thymoma nodule. Mitotic figures were found in both the original tumor and the separate pulmonary nodule. They were unable to find a similar case in the literature. They give a detailed case history and autopsy report.—*C. P. Truog, M.D.*

HOWARTH, SHEILA. Blood-pressure changes during angiocardiography. *Brit. M. J.*, Nov. 11, 1950, *2*, 1090–1091.

The author reports the observation of consistent blood pressure drops in 6 patients because of a feeling that any changes are worthy of note in view of the increasing number of accidents reported as a result of angiocardiography. In 5 of the 6 cases there were intracardiac shunts on a congenital basis and the last, or sixth, case was a case of pulmonary hypertension associated with chronic bronchitis and bronchiectasis. There was a conspicuous fall in blood pressure in every case following injection of the opaque medium (diodone). These patients were all non-reactors to iodine sensitivity tests.

The fall in blood pressure occurred from six to twenty seconds after injection and at the same time there was a fall in pulse pressure. A control injection of saline given in the same bulk at the same rate as that of diodone produced no change in the blood pressure.

The mechanism of this fall in blood pressure is undetermined. It is suggested that the probable source of the change depends upon a peripheral action of the drug, either directly on the arterioles or indirectly through sino-aortic or other reflex mechanisms.—*A. J. Present, M.D.*

ORTNER, ALVIN B., and GRISWOLD, R. ARNOLD. Chronic occlusion of the bifurcation of the aorta. *Arch. Surg.*, Nov., 1950, *61*, 793–803.

Occlusion may be the result of an acute saddle embolus or form gradually as a progressive thrombosis. The underlying cause of the thrombosis of the terminal aorta is atheromatosis of the aorta and the iliac arteries.

The typical symtomatology is (1) easy fatigability of the lower extremities, (2) intermittent claudication, (3) pain in the calves and thighs and frequently the hips and the lower part of the back, (4) coldness of the feet, and (5) in the male the inability to have or maintain an erection.

The usual physical findings are (1) absence of pulsation in the lower segment of the aorta and the arteries of the lower extremities, (2) pallor of the skin of the legs and feet which may be present even when they are dependent, (3) symmetric atrophy of the musculature of the lower limbs (this may be difficult to appreciate as both limbs may be affected equally), and (4) trophic changes of the skin and gangrene, which are late and are usually terminal findings.

Death frequently occurs before the onset of gangrene from other complications of arteriosclerosis or from renal failure due to obstruction of the renal arteries by the thrombosis.

Diagnosis may be confirmed by aortography. Therapy is directed toward the improvement of the circulation distal to the obstruction by release of vasospasm by lumbar ganglionectomy.

Three cases are reported, all of whom improved after treatment. The authors feel that lumbar ganglionectomy alone is sufficient to bring about the release of the vasospasm.—*R. K. Arbuckle, M.D.*

GOODWIN, WILLARD E., SCARDINO, PETER L., and SCOTT, W. W. Translumbar aortic puncture and retrograde catheterization of the aorta in aortography and renal arteriography. *Ann. Surg.*, Nov., 1950, *132*, 944–958.

The authors review the techniques and results of translumbar aortic puncture and retrograde catheterization of the aorta in aortography and renal arteriography.

In 1 case, the needle method was used to demonstrate pathologic changes in the left iliac artery. In another case the same technique was used to demonstrate the circulation to a calcified pelvic aneurysm of the right hypogastric artery.

Retrograde femoral artery catheterization of the aorta was carried out 15 times with no serious complications or reactions. In only 2 cases, however, was information gained that would not have been learned from the translumbar needle puncture method.

Aortography, by both methods, was found to be a safe and often useful procedure. It is of value in all

cases of imperfectly visualized kidneys and of renal masses of doubtful nature. It unquestionably has great use in vascular lesions involving the aorta and its branches.

The chief advantage of the catheter method lies in the possibility of placing the contrast medium at any level.

The needle method is, however, much simpler and quicker after facility is gained in the technique of aortic tap, and the complications are fewer. It is believed to be the procedure of choice in aortography.—*C. D. Frey, M.D.*

Decker, Fred H., and Fash, James C. Congenital defect in the diaphragm: a case report. *Radiology*, Sept., 1950, *55*, 415–418.

Roentgen examination is the most reliable and usually the only method of establishing the diagnosis of congenital defect in the diaphragm.

Arey states that the diaphragm is derived from four sources: (a) the septum transversum, which forms the ventral portion; (b) the pleuroperitoneal membrane, which forms the lateral portion; (c) the dorsal mesentery, from which comes the median dorsal portion; and (d) derivatives from the body wall.

Thorek proposes the following classification of congenital diaphragmatic hernias:

(1) Posterolateral—along the embryonic pleuroperitoneal canal (foramen of Bochdalek).
(2) Retrosternal (foramen of Morgagni).
(3) Those through the esophageal hiatus.

Dyspnea, cyanosis, and general physical distress, occurring together in a newborn infant and sometimes accompanied by vomiting, are suggestive of diaphragmatic defects. Fluoroscopy and roentgenograms are diagnostic. Surgical repair is quite successful and should be done early.

A case in a newborn infant is reported with autopsy findings. The infant had a large defect posterolaterally in the left diaphragm with most of the intestinal tract in the left hemithorax. The authors suggest that death was due to mechanical pressure exerted on the aerated lung tissue by the distended bowel leading to collapse of the lung, anoxia, and cardiac embarrassment.—*E. M. Cooper, M.D.*

García Capurro, F., and Arias Bellini, M. Pseudo-cystic shadows of the right pulmonary base due to diaphragmatic omental hernia. *Radiology*, Sept., 1950, *55*, 410–414.

Four cases of diaphragmatic herniations of the omentum through the foramen of Morgagni are described. The developmental errors involving the diaphragm and predisposing to hernia are discussed.

Characteristic roentgen features show a dense mass of regular outline, similar to a cyst, forming a semicircle in contact with the diaphragm at a point where the latter seems to be interrupted, forming two lateral arcs. There is immobility of the diaphragm with a possible paradoxical movement of the shadow The duodenum may be displaced to the upper right abdomen and there may be an insinuation of the transverse colon near the pathological shadow.

If the hernia is a true one, pneumoperitoneum will demonstrate an accumulation of air around the pathological shadow; if it is a pseudohernia, without a peritoneal sac, a pneumothorax will develop.—*F. E. Seedorf, M.D.*

Abdomen

Olivier, C., Albot, Guy, and Libaude, H. La radiomanométrie biliaire avec enregistrement graphique. (Biliary radiomanometry with graphic recording.) *Presse méd.*, Oct. 4, 1950, *58*, 1066–1068.

For eight years, the authors have studied biliary pressures according to the principles of Caroli. Using his perfusion apparatus, they introduce an opaque fluid into the biliary passages under known pressure. Simultaneous roentgenoscopy permits determination as to when the fluid passes the cystic duct and the sphincter. As their research progressed, they added the concept of residual pressure. In addition to noting the threshold for the production of pain, other observations were made bearing particularly on how the residual pressure is established, whether rapidly or slowly, continuously or in steps.

It is desirable that the apparatus permit determinations to be made and decisions arrived at during or after operation. Recently, an attempt has been made to replace roentgenoscopy by roentgenography. A preliminary approximate measure of the pressure of passage is obtained using a non-opaque fluid. The fall of the fluid level in the inverted flask and the sound made by air replacing the fluid in a Caroli apparatus gives this information. The procedure is repeated with tenebryl while the recording cylinder operates continuously. The pressure is fixed 4 cm. below the approximate level and a roentgenogram is made. A second film is made if there is reason after establishing the first residual. The pressure is raised 2 cm. and finally to the level of presumed free flow. Each step is controlled by two roentgenograms one to record passage, the other to record residual. The entire test takes about twenty minutes.

Three cases are given in detail to illustrate the practical value of the procedure.—*M. L. Sussman, M.D.*

Lounsbury, Benjamin F., Douglass, Thomas C., and Carroll, Walter C. Operating room cholangiography. *Quart. Bull. Northwestern Univ. M. School*, Fall, 1950, *24*, 169–171.

The authors use 35 per cent diodrast to visualize the biliary ducts at the time of surgery. A tunnel for a 14 by 17 inch film cassette is placed under the patient before surgery is started. Following clamping of

the cystic duct, 5 cc. of diodrast is injected and a film is exposed, then an additional 15 cc. is injected and a second film is taken. It seems important to have the anesthetist cause the patient to suspend respiration at the time of the film exposure. The surgeon can close the abdomen confident that he has an open common bile duct following this study.—*V. L. Peterson, M.D.*

MECHLING, ROBERT S., and WATSON, JAMES R. The solitary gallstone. *Surg., Gynec. & Obst.*, Oct., 1950, *91*, 404–408.

Solitary gallstones are often interpreted as harmless occupants of the gallbladder and, when found during the course of routine health examinations, are apt to be dismissed as unimportant findings if they are not producing symptoms. The purpose of this paper is to demonstrate that the solitary stone produces the same signs and symptoms as those caused by multiple stones, that it causes the same complications, and that these occur with sufficient frequency to make its presence, even when asymptomatic, a positive indication for cholecystectomy.

Conclusions

1. Solitary gallstones were found in 21.18 per cent of 387 consecutive cases of cholecystitis with cholelithiasis.

2. Solitary stones occurred slightly oftener in the male than in the female.

3. Complications occurred in 41.47 per cent of the cases of solitary stone as compared with 29.84 per cent for the cases of multiple stones.

4. Their surgical management resulted in a mortality rate of 3.65 per cent as compared with a mortality rate of 1.63 per cent for the multiple stones.

5. A cholecystographic report of the presence of gallstones is highly reliable. Any report as to the number present is unreliable.

6. The demonstration of a solitary gallstone by cholecystography is as much an indication for cholecystectomy as is the report of multiple stones.—*Mary Frances Vastine, M.D.*

DEAN, GEOFFREY. Seven cases of barium carbonate poisoning. *Brit. M. J.*, Oct. 7, 1950, *2*, 817–818.

Seven patients were accidentally given barium carbonate for barium meal investigations. Pure barium carbonate is a white powder similar in appearance to barium sulfate and is commonly used as a rat poison. It had been placed by mistake in the barium sulfate container at the wholesale premises and was therefore dispensed instead of barium sulfate in the preparation of a barium cream supplied to radiologists. The amount administered in all cases, except the fatal one, was a glassful, equivalent to 4.26 oz. (133 gm.) of dry barium carbonate. In the fatal case, half this quantity was administered.

The dose given in all cases was many times that usually considered lethal. The large amount of barium carbonate caused rapid onset of vomiting and diarrhea which may account for recovery where a smaller dose might have been fatal. In the one fatal case, the administration of the barium carbonate was followed by heavy sedation and anesthetic which delayed vomiting and purging. Magnesium sulfate which was given in some cases proved an excellent antidote.

The author suggests that barium carbonate, which in its pure form is a white powder, should be colored by a distinctive dye so that this mistake does not occur again.—*J. J. McCort, M.D.*

FETTER, JOHN S., and MILLS, WILLIAM L. Roentgenographic findings in Schönlein-Henoch's purpura; case report. *Radiology*, Oct., 1950, *55*, 545–547.

The clinical, laboratory and roentgenographic findings of an adult male with Schönlein-Henoch's purpura are presented. In addition to the characteristic skin petechiae, the patient experienced persistent epigastric pain and vomited blood-tinged material. A roentgen examination with barium meal revealed a constrictive obstruction at the beginning of the third portion of the duodenum. Dilatation occurred proximal to this. After twenty minutes the duodenum distal to the obstruction was visualized, and the mucosal pattern was shown to be distorted by widening and irregular filling of the mucosal folds.

Following four months' supportive treatment the roentgen examination of the entire small bowel was negative and the patient was symptom free.—*E. E. Seedorf, M.D.*

ESPOSITO, JOSEPH J. Small intestinal abnormalities in anaphylactoid purpura. *Radiology*, Oct., 1950, *55*, 548–552.

This is a report of 2 cases of Schönlein-Henoch's purpura with roentgen evidence of small intestinal changes.

This type of purpura is characterized by a skin "rash," gastrointestinal and joint symptoms. It is usually found in male children. Since the gastrointestinal symptoms frequently precede the development of the skin changes, many cases are confused with appendicitis, ileitis, and intussusception.

Gastrointestinal examination in these 2 reported cases showed widening of the mucosal folds, narrow irregular loops of small intestine, dilatation, segmentation, and hypomotility. After the patients recovered, the small intestinal examination showed a normal mucosal pattern and motility.

The small bowel changes are probably due to intramural hemorrhages which give local mucosal changes and to intramesenteric hemorrhages which lead to neuromuscular derangements.—*C. A. Stevenson, M.D.*

MARTIN, JAMES F., and SAUNDERS, HENRY F. Gastric ulcer in childhood; report of a case. *Radiology*, Nov., 1950, *55*, 728–730.

Gastric ulcer is a rare condition in children. The clinical and roentgenographic findings of an acute gastric ulcer in a white boy, six years of age, are reported. The patient had abdominal pain for a week's duration, vomited dark blood and blood was detected in the stool.

Roentgen studies revealed an ulcer niche 1 cm. in diameter on the lesser curvature near the pylorus.

Medical therapy rapidly relieved the clinical symptoms and produced healing of the ulcer as demonstrated roentgenographically in about six weeks.—*E. E. Seedorf, M.D.*

Friedman, Robert L., and Epstein, Bernard S. Benign gastric ulcer of the greater curvature. *Radiology*, Sept., 1950, *55*, 398–402.

This is a report of 2 cases of benign gastric ulcer occurring on the greater curvature of the stomach, 1 near the middle third and the other in the pyloric third.

The authors suggest that if, as in these 2 reported cases, the rugae converge towards the ulcer crater on the greater curvature the ulcer may be benign. Nevertheless, they recommend surgery for all greater curvature ulcers because of the high incidence of malignancy.—*C. A. Stevenson, M.D.*

Leigh, Ted F. Calcified gastric leiomyoma: report of a case. *Radiology*, Sept., 1950, *55*, 419–422.

Microscopic calcification in leiomyoma of the stomach frequently occurs; however, grossly calcified gastric smooth muscle tumors are exceedingly rare. A review of more than fifty articles on leiomyoma of the stomach revealed only 1 case similar to the one reported here.

A case of a gastric leiomyoma in a British West Indian Negro, aged fifty-eight, is reported. His complaints were nausea, vomiting, weakness, and low-grade fever of about one month's duration. Physical findings were not significant. An anteroposterior abdominal film revealed a large area of irregular opacities in the left upper quadrant. A barium enema revealed that the mass lay outside the colon. Examination of the stomach showed the calcium shadows to be partly within and partly without the left lateral and posterior gastric wall. The stomach was partially obstructed by the mass.

At operation a globular mass about 10 cm. in diameter was found arising from the greater curvature. When sectioned, this mass was found to be diffusely calcified. The histopathological diagnosis was leiomyoma.

The patient died twenty-four hours following surgery, presumably from postoperative shock. The leiomyoma was confined to the primary site.—*E. M. Cooper, M.D.*

Garbarini, J., and Price, H. P. Calcified leiomyoma of the stomach. *New England J. Med.*, Sept. 14, 1950, *243*, 406–407.

The authors report the case of a fifty-four year old male who complained of a persistent dull pain in the left upper quadrant and a weight loss of 30 pounds. Roentgenograms of the barium-filled stomach revealed an extensive filling defect involving the middle gastric region. There was also evidence of a "pepper and salt" type of calcification in an adjacent lesion which lay anterior to the stomach. This lesion together with the distal two-thirds of the stomach was resected and the mass proved to be a partially calcified leiomyoma 8 cm. in diameter. A sinus tract led into the center of the tumor but otherwise the gastric mucosa was smooth. The hyaline changes and calcification were similar to those seen in uterine fibroids and bore no relation to the superimposed chronic suppuration which was present.—*A. E. Childe, M.D.*

Lahey, Frank H., and Marshall, Samuel F. Should total gastrectomy be employed in early carcinoma of the stomach? Experience with 139 total gastrectomies. *Ann. Surg.*, Sept., 1950, *132*, 540–565.

The authors point out the marked surgical mortality rate in radical total gastrectomy in their own series of 139 cases, and also other reported series by various investigators. Since 1944, the mortality rate (9.4 per cent in this series) is comparable to the mortality rate in partial gastrectomy for gastric neoplasm. The authors urge employment of total gastrectomy in a greater number of patients, particularly in the early cases. They believe that the more radical surgical procedure will improve the five-year survival rate in malignant disease of the stomach. Radical gastrectomy is a most necessary procedure, even in the grossly early lesions, as there is a tendency not only to spread to the adjacent lymph nodes, but also to invade blood vessels, and to show diffuse submucosal spread in the gastric and duodenal wall well beyond the gross tumor. The authors point out the necessity of resecting the duodenum as close to the ampulla of Vater as possible, in order to remove the submucosal spread of tumor cells from the primary gastric malignancy.

The surgeon who selects this radical type of operation must weigh the following factors before proceeding with such an operation: his technical skill and surgical experience, the quality and character of the anesthesia, the capacity of the patient to endure such a long and trying operation, and the surgeon's and his associates' ability to deal with the changes in conditions which will inevitably be associated with such extensive operations.—*E. A. Addington, M.D.*

Skoog-Smith, Anton W., Jaspin, George, and Sullivan, Joseph V. Gastrojejunocolic fistulas; postoperative complications in nineteen cases. *Surg., Gynec. & Obst.*, Oct., 1950, *91*, 447–454.

Gastrojejunocolic fistula is an abnormal communication between the stomach, jejunum and colon. It

occurs predominantly in males. In each of the 19 reported cases, the development of the fistulous tract was preceded by operative procedures performed for relief of duodenal ulcer; the operative method used most frequently was the posterior gastroenterostomy. In 5 of the authors' cases the type of gastroenterostomy was not specified but it is believed that the kind performed was most likely the posterior anastomosis. The previous surgical creation of an abnormal shunt is therefore necessary for development of a gastrojejunocolic fistula. This sequence is applicable to those cases in which the operation has been performed for the treatment of a duodenal ulcer. In this particular series, the fistulous tracts developed in periods varying from one and a half to twenty-one years after the primary surgery. A fistula developing as the result of carcinoma need not be preceded by surgical intervention.

The fistulous tract usually involves the site of gastrojejunal anastomosis and occasionally may be located in the efferent loop of jejunum. The symptoms of the fistula in order of frequency are: diarrhea, weight loss, pain, vomiting, fetor oris, and hemorrhage.

Barium enema offers the most accurate means of diagnosis. The treatment of choice at this time is entirely surgical and consists of dismantling of the gastroenterostomy, resection of the fistulous tract and involved jejunum, end-to-end anastomosis of the jejunum, closure of the defect in the colon, and subtotal gastrectomy with gastrojejunostomy. Three case histories are reported in greater detail because of their special interest: one is that of a child of fourteen years; the second is that of a patient who developed a total of three fistulous tracts, two of these occurring simultaneously; the third is that of a patient with a fistulous tract involving the proximal or afferent loop of jejunum.—*Mary Frances Vastine, M.D.*

WERNER, JOACHIM. Über den Pylorospasmus der Säuglinge. (Pylorospasm of nurslings.) *München. med. Wchnschr.*, Sept. 1, 1950, *92*, 858–859.

The author describes an operative series of 31 cases, 27 of which had actual hypertrophic pyloric stenosis. He emphasizes the constitutional background. Abnormal restlessness, struggling, trembling, persistent crying, ready startling, insomnia, and a tendency to have frequent thin, slimy stools were considered as evidence of a spasmophilic constitution and a "neuropathic diathesis."

Follow-ups were obtained in 16 cases. The patients came from small families, with an average of 2 children, characterized by a marked difference in the ages of the siblings. There were 3 male cases to 1 female, and they were almost always breast fed. Seven had acrocyanosis and abnormal sweating episodes, while 9 were characterized by a generalized weakness of vegetative function with easy fatigability and exhaustion. Psychiatrically they were characterized by ready startling and crying spells in early infancy. Four were unusually voracious at nursing, and others had diarrhea and intestinal disturbances. Older children, up to the age of ten, showed neurasthenic characteristics, such as anxiety, dissatisfaction, anorexia nervosa, and persistent bedwetting, more frequently than their normal siblings.

No heriditary tendency to gastrointestinal disease could be demonstrated, but more than half of the parents had some degree of nervous instability.—*John J. B. Light, M.D.*

FRUGONI, C. Il punto di vista italiano sulle sindromi bantiane. (The Italian viewpoint on Banti's syndrome.) *Schweiz. med. Wchnschr.*, Sept. 9, 1950, *80*, 957–963.

The author gives a chronological discussion of the pure Banti syndrome and its many variations, quoting a host of authors itemizing the differences.

He concludes that the Banti syndrome is a necessity. It is a clinical entity not necessarily fixed and immutable to which varied etiological factors are attributed.

The pure Banti syndrome is extremely rare. It is characterized by chronic splenomegaly, congestive or sclerotic in type; hepatic cirrhosis and a splenoinhibiting anemia; alterations of the splenic portal vascular system ending in gastrointestinal hemorrhage; and is cured by splenectomy in the early stage of the disease.—*N. M. Albanese, M.D.*

BURKITT, ROBIN. The massive hydronephrosis presenting as an abdominal emergency. *Brit. J. Urol.*, Sept., 1950, *22*, 208–210.

Four cases of massive hydronephrosis are discussed in detail. All 4 cases had remained latent until a sudden catastrophe had precipitated symptoms. In 2 cases this catastrophe was believed to be infection; in 1, hemorrhage; and in 1, traumatic rupture. The causes of the hydronephrosis were stones in 1 case, papilloma in another, aberrant vessels in the third, and unknown in the fourth. In all but 1 case an anterior abdominal approach was used, and the kidney stones removed without difficulty.—*R. F. Niehaus, M.D.*

HINDEMITH, H., and RHODE, M. Erkennung und Behandlung des Phäochromozytoms. (Diagnosis and treatment of pheochromocytoma.) *München. med. Wchnschr.*, Oct. 13, 1950, *92*, 1081–1092.

The importance of chromaffin tumors in paroxysmal hypertension has been recognized. The picture of a pheochromocytoma can vary considerably and early diagnosis is of importance, since the only satisfactory therapy depends upon the early removal of the tumor.

The correct diagnosis can be made by palpation of

the tumor and by provocation of a crisis by the benzo-dioxan or dibenamine test, in which the dangerous crisis can be suppressed and interrupted.

Roentgen diagnosis of these tumors may be helpful. The tumor can be recognized on a film of the abdomen or by means of contrast examination of the kidney. The kidney may be either depressed or rotated around its axis due to a tumor above the upper pole. Such a tumor also may produce a deformity of the superior calyces and the superior portion of the kidney pelvis. Tomographic studies have proved particularly helpful in cases in which the tumor was too small to cause any signs of deformity or depression of the kidney. Perirenal air insufflation also has been used successfully. A pneumoperitoneum, however, did not prove of great help in the recognition of pararenal tumors.

If, on repeated roentgen examination, no tumor in the region of the adrenal can be found, a paraganglioma in the thorax or neck should be considered. The treatment of choice remains surgery.—*H. P. Mueller, M.D.*

Mayo, Charles W., and Blunt, Charles P. Vesicosigmoidal fistulas complicating diverticulitis. *Surg., Gynec. & Obst.*, Nov., 1950, *91*, 612–616.

This paper is based on 46 cases in which vesicosigmoidal fistula complicated diverticulitis of the large intestine. Thirty-nine of the patients were men and 7 were women. The ratio of males to females, therefore, was approximately 5 to 1. The most logical explanation for this difference is the intervention of the uterus between the sigmoid and bladder. The ages of the patients ranged from twenty-nine to seventy-six years, the average age being fifty-two years. The average duration of symptoms was 16.8 months. Proctoscopic, and roentgenographic examinations are indicated in cases in which the presence of a vesicosigmoidal fistula is suspected.

Surgical treatment is recommended in cases in which a vesicosigmoidal fistula complicates diverticulitis of the large intestine. The operation that was employed most frequently consisted of some type of extraperitoneal resection of the sigmoid and closure of the opening in the bladder. Next in order of frequency was resection of the sigmoid with end-to-end anastomosis and a preliminary or concomitant colostomy. The operation that was employed least frequently consisted of resection and end-to-end anastomosis without colostomy.

In 3, or 6.5 per cent, of the 46 cases, the patients died in the hospital. The preoperative and postoperative use of antibiotics has added much to the safety of resection of the large intestine.

Primary resection of the sigmoid with or without colostomy and closure of the vesical opening will probably be employed with increasing frequency in the treatment of this condition.—*Mary Frances Vastine, M.D.*

Solomon, Harry A., and Kreps, Sidney I. Twenty-six years of survival following carcinoma of sigmoid with prolonged liver metastasis. *J.A.M.A.*, Sept. 16, 1950, *144*, 221–224.

A twenty-six year old white woman, following surgical removal of an annular adenocarcinoma of the sigmoid, twenty-six years later developed a large, solitary, slow growing metastasis in the liver. Further metastases were found in the adjacent perihepatic and periaortic lymph nodes. Necropsy did not disclose any other primary neoplasm or any evidence of recurrence at the original site. This case is unusual in that the metastasis was so late and also in the slow, three year growth of the liver metastasis before pressure of the mass impeded the portal circulation causing mild ascites, pleural effusion and development of esophageal varices. The incidence of local recurrence and metastasis is reported as 25–50 per cent while the average survival period of carcinoma of colon, with recurrence following resection, is reported as 14–33 months.—*G. H. Ramsey, M.D.*

Bonorino Udaondo, Carlos, and D'Alotto, Victorino. Sigmoiditis diverticular; sus relaciones con el cáncer. (Diverticular sigmoiditis; its relation to cancer.) *Prensa méd. argent.*, Sept. 1, 1950, *37*, 2023–2027.

The authors do not believe that sigmoidal diverticulitis can be generally considered an etiologic factor in the development of sigmoidal carcinoma. They agree with the conclusions of Blanchard-Wilson that "when a tumor simulates diverticulitis and the tumefaction only partly can be attenuated, the symptoms more or less persisting, carcinomatous degeneration is to be assumed and resection is indicated." Cancer of the rectum, which is more frequent than that of the sigmoid, may be masked by the more prominent symptoms of sigmoiditis. Endoscopic examination is obligatory in all cases.—*E. A. Schmidt, M.D.*

Moretz, William H., and Morton, John J. Acute volvulus of small intestine; analysis of 36 cases. *Ann. Surg.*, Nov., 1950, *132*, 899–912.

This comprehensive article analyzes 36 cases of acute volvulus of the small intestine seen at Strong Memorial and Rochester Municipal Hospitals, Rochester, N. Y., from 1925 to 1947. It presents an excellent summary of the condition and emphasizes the urgency of prompt surgical relief.

The preoperative diagnosis is difficult, and undue delay with conservative management in the presence of a possible volvulus is fatal. The diagnosis of volvulus was made correctly in 7 cases. The diagnosis of small bowel obstruction was made in 17 cases. No preoperative diagnosis was recorded in 8 cases.

A roentgenogram of the abdomen was taken in 27

patients. Nineteen of them showed evidence of small bowel obstruction; 2 showed evidence of large bowel obstruction; 1 showed free air in the right upper quadrant with evidence of fluid in the peritoneal cavity. The roentgenograms were normal in 5 patients.—*J. J. Gormley, M.D.*

FRASER, ROBERT G., and PEIRCE, CARLETON B. The differentiation of diverticulitis and carcinoma of the large bowel: a roentgenologic problem. *J. Canad. A. Radiologists*, Sept., 1950, *1*, 39–47.

This excellent paper is a comparative analysis of 159 verified cases of which 91 are carcinoma, 66 are diverticulitis, and 2 represent a combination of both lesions. The authors emphasize that in the absence of a positive biopsy by sigmoidoscopy the differential diagnosis between diverticulitis and carcinoma of the distal colon and sigmoid is primarily a roentgenological problem. They point out that there is a marked similarity in the clinical history and physical findings. Local tenderness, a palpable mass, and spasm are common to both conditions. Melena is unusual in diverticulitis and, with the presence of bleeding, carcinoma should be strongly considered. In the roentgen differential diagnosis the writers consider 3 main points: (1) the presence or absence of diverticula; (2) the character of the mucosal pattern with preservation of the mucosa in diverticulitis and its destruction in carcinoma; (3) the length and contour of the lesion with the lesion being long and ill defined in diverticulitis and short and sharply defined with overhanging edges in carcinoma.

Concomitant diverticulitis and carcinoma were present in 1.3 per cent of the cases of this series. No etiological relationship has been established between the two.

The roentgen-diagnostic error is reported as 9.4 per cent in this group of patients. The majority of these were reported as negative and later found to have carcinoma in 6 cases and undemonstrated diverticula in 2 cases. The authors believe that the lack of spot films is responsible for the failure of detection of lesions.

Lymphosarcoma, syphilis, and endometriosis must also be considered from the point of view of differential diagnosis.—*T. D. Allison, M.D.*

YATES, C. W., MORETON, R. D., and COOPER, E. M. Double-contrast studies of the colon with special reference to preparation and fictitious polyps. *Radiology*, Oct., 1950, *55*, 539–544.

In an attempt to arrive at the best method of preparing the patient for a double contrast examination of the colon, the authors found that the withholding of supper the night before the examination decreased the amount of fecal material in the right colon. A light breakfast did not seem to interfere with the production of good double contrast roentgenograms.

In order to determine the effectiveness of various types of laxatives and enemas, the guide to their efficiency was whether or not satisfactory double contrast roentgenograms were produced.

Soapsuds enemas cleaned out the left colon better than hypertonic saline, normal saline or tap water. The laxatives investigated showed castor oil to be the most efficacious.

From their investigations the authors state that the best preparation for the double contrast examination of the colon is as follows:

(a) Eat no supper on previous day.
(b) At 6 p.m., take 1 oz. of castor oil, disguised, if preferred, with root beer, etc.
(c) Beginning at 6 a.m., take three small soapsuds enemas at 15-minute intervals (use soap on enema tip rather than grease).
(d) Have a small breakfast at 7 a.m.
(e) Colon examination at 8 a.m.

—*C. A. Stevenson, M.D.*

LEE, C. MARSHALL, JR., BEBB, KENNETH C., and BROWN, JOHN R. The selective management of megacolon in infants and children. *Surg., Gynec. & Obst.*, Sept., 1950, *91*, 281–295.

Three general types of megacolon may be recognized:

(1) The organic or symptomatic megacolon in which the enlarged bowel is secondary to an obstruction which is grossly demonstrable. The obstruction may be caused by stricture, by congenital stenosis, or by tumor.

(2) The aganglionic or achalasic megacolon (true Hirschsprung's disease). The colonic dilatation in this case is secondary to incomplete obstruction caused by the absence of parasympathetic ganglia in the terminal segment of the bowel. Persistent and increasing impaction of the bowel content complicates the narrowing and adds to the obstructive phenomenon. Roentgenologically, the dilatation is seen to end in the lower sigmoid or upper rectum. Below this point the lumen is normal looking or slightly narrowed.

This condition is characterized by constipation from birth. Early, only the descending colon and sigmoid are affected but later the dilatation and hypertrophy extend higher and higher until the whole colon is involved.

(3) Idiopathic megacolon. In this group of cases no definite etiological basis can be established. Such factors as faulty bowel habits, spastic sphincter and excessive water absorption from a congenitally elongated sigmoid may be responsible.

Treatment. In the first type of case, the organic or symptomatic megacolon, the obstructing mechanism is grossly apparent and the treatment is necessarily surgical.

In the second type, the true Hirschsprung's colon,

surgery, unless it includes removal of the entire rectum, will be ineffectual. Sympathectomy is ineffective. When the rectum has been removed, the terminal segment and upward for a variable distance will show a complete absence of parasympathetic ganglia usually in both the myenteric and the submucous plexuses. The surgical treatment of these cases poses a problem and there is no unanimity of opinion as to just what measures the surgical treatment should consist of.

In the idiopathic megacolon the treatment is nonoperative in the majority of cases. Dilatation of the sphincter and the regular use of enemas, conscientious bowel training, mild laxatives, and such drugs as mecholyl bromide may effect a lasting cure.—*Mary Frances Vastine, M.D.*

Duperrat, B. Les lymphomes benins du rectum. (Benign lymphomas of rectum.) *Presse méd.*, Oct. 18, 1950, *58*, 1149–1150.

Benign lymphomas of rectum are relatively rare. Few cases have been described in the literature. The author reports 10 cases. These lesions are found as often in men as in women. They occur at all ages from six to seventy-one years. The symptoms are indefinite, one of the following being usually encountered: pain, constipation, hemorrhages and a sensation of foreign body in the rectum. The four symptoms are seldom all present in one case. It may take as long as ten to fifteen years for a rectal lymphoma to fully develop.

The endoscopist often finds them at the junction of the stratified and glandular mucosa. Other lesions have been found above that level. They are sometimes multiple and tend to coalesce into plaques or rings. Diffuse lesions are seldom seen. They range in size from a pinhead to a small orange, most commonly being the size of a hazelnut. They may be sessile or pedunculated, in which case they are indistinguishable from polyps. They are often accompanied by mechanical and inflammatory manifestations.

Pathologically, these tumors are not found at the same level as the lymphoid follicles which are between the muscularis mucosae and the mucosa, but arise in the loose cellular layer between the muscularis mucosae and the musculosa. Histopathologically, they are non-capsulated polycyclic lesions which could be mistaken for lymph follicles. They are made up of a germinating center containing large lymphoblasts showing numerous mitoses and surrounded by adult lymphocytes without mitotic figures.

These cells are held together by a fine reticulum. They usually invade the muscularis mucosae and often the mucosa itself. If the musculosa is invaded, degenerescence is suspected.

The diagnosis can only be made histopathologically. Clinically, no changes occur in the circulating blood. No enlarged lymph nodes are felt and the spleen is not enlarged. The prognosis is excellent, provided surgical excision is complete. Radiation therapy is indicated only ofter surgery when follicles are large or multiple.—*J. P. Jean, M.D.*

Pfeiffer, Damon B., and Miller, David B. Cancer of the rectum; five and ten year follow-up study of cases of cancer below the peritoneal reflection. *Surg., Gynec. & Obst.*, Sept., 1950, *91*, 319–322.

The subject of suitable operations for cancer of the rectum has come under considerable scrutiny during the past few years. In particular, the question pertains to the Miles operation, the Hochenegg or "pull through" operation, and anterior resection. Reference has been made by several authors to the level of the lesion in determining the choice of operation. Waugh and Kirklin at the Mayo Clinic have used careful proctoscopic measurements as a guide, while Gilchrist and David have urged the anterior peritoneal reflection as a suitable landmark. This series of cases was analyzed to determine the results of the Miles operation for cancer of the rectum proper.

Summary

1. One hundred eighty cases of carcinoma of the rectum lying below the peritoneal reflection are reviewed.

2. One hundred fourteen radical resections were performed with an over-all five year survival rate of 37.2 per cent.

3. On the basis of this series, as well as that of Gilchrist and David, the prognosis for cancer lying below the peritoneal reflection is considerably poorer than for cancer of the rectum and "rectosigmoid" in general.

4. Since the prognosis for cancer lying below the peritoneal reflection is poor following radical abdominoperineal resection, anterior resection or the Hochenegg type of operation would accomplish even less in the way of long term survival and should not be used.

5. It is urged that the peritoneal reflection be considered as a guide to differentiate between cancer of the rectum and cancer of the sigmoid, thus eliminating use of the vague term "rectosigmoid."—*Mary Frances Vastine, M.D.*

Gynecology and Obstetrics

Siegler, Samuel L., Ravid, Jacob M., and Tobin, Sidney M. An appraisal of chorionepithelioma based on observations in twelve cases. *Am. J. Obst. & Gynec.*, Sept., 1950, *60*, 586–604.

The incidence of chorionepithelioma is extremely variable, ranging from 0.019 per cent to 3 per cent, and that of malignancy of hydatidiform moles from 1.3 per cent to 50 per cent, depending upon the criteria used by various authors. In the cases herein reported the age range was from nineteen to forty-

eight years. The multipara is more susceptible to choriomatous formation than the primipara (3:1).

Fifty per cent of chorionepitheliomas follow a hydatidiform mole, 25 per cent a full term pregnancy, and 25 per cent an abortion. When the diagnosis of mole is made, the uterus should be emptied immediately, preferably by the vaginal route. When a patient has a large mole, particularly when she has had many children or is near the menopause, hysterectomy is the treatment of choice. A diagnostic curettage should be done promptly if persistence or recurrence of vaginal bleeding takes place and/or a positive Aschheim-Zondek test has been excluded.

The Aschheim-Zondek test is indicated in the following situations:

1. Recurrence of vaginal bleeding following a full term pregnancy, abortion, or removal of a hydatidiform mole.

2. Periodic Aschheim-Zondek tests should be performed to evaluate the prognosis after surgical removal of a proved case of chorionepithelioma.

If large masses of trophoblastic tissue are found showing definite evidence of anaplasia, the diagnosis is simple. In 2 fatal cases, well preserved villi and masses of anaplastic trophoblastic tissue were present in the same section. The authors believe that the qualitative or atypical changes of the individual cells, and especially their nuclei, constitute the most reliable guide to malignant potentialities. Thus it is the disparity in size and shape, hyperchromatism instead of pyknosis of the syncytial cells and pleomorphism of Langhans' cells with mitoses, that makes for malignancy.

Chorionepithelioma behaves like a sarcoma. Its inherent tendency to invade the blood vessels, combined with its local invasive and destructive nature, account for the widespread dissemination. The broad ligament structures, including the ureter and not infrequently the tube and ovary, may be invaded. The cervix and bladder are frequently involved. Vaginal and vulvar metastases have been recorded. They appear as isolated dark-red or bluish raised nodules which resemble an old hematoma. On section, they give the appearance of a blood clot. Distant metastases are hematogenous and involve most frequently the lungs, brain, liver, and kidney, in this order of frequency.

Of 12 cases in this series:

1. Eleven may be classified as chorionepithelioma of varying degrees of malignancy: (a) Six died within seven to thirty months after the removal of the original mole or onset of symptoms of the disease. (b) Five are still alive and free from any discernible clinical signs or symptoms of the disease and have negative Aschheim-Zondek tests from four to fifty-two months following the initial removal of the mole.

2. One patient who had chorioma destruens or malignant mole is alive. She has been clinically and biologically free of the disease for ten years following initial removal of the mole. All patients should be operated upon as soon as the diagnosis is made, for the death rate increases directly in proportion to the delay in diagnosis and treatment. A total hysterectomy and bilateral salpingo-oophorectomy must be perfomed regardless of the age of the patient. The operation should be followed routinely by a course of irradiation. Periodic Aschheim-Zondek tests should be done.

When metastases are present, is surgery justified? If the metastases are located solely in the pelvis or perineum, a panhysterectomy and surgical extirpation of the metastatic nodules, wherever possible, should be done. If the nodules are surgically inaccessible, they are treated by irradiation.

When distant metastases exist, irradiation is the treatment of choice in most cases. Recently large doses of estrogens have been used upon the primary as well as the metastatic tumor and have been found to alleviate some of the symptoms.—*S. N. Tager, M.D.*

EKENGREN, KRISTINA, and RYDÉN, ÅKE, B. V. Roentgen diagnosis of tuberculous salpingitis. *Acta radiol.*, Sept., 1950, *34*, 193–214.

Definitely established tubal tuberculosis has been studied roentgenologically in 75 cases and compared with control material. It has been possible to distinguish 7 types of salpingograms which are in a greater or less degree characteristic of tubal tuberculosis.

1. Slightly dilated club-like tubes with an even contour and no mucous membrane relief closed in the region of the isthmus or proximal ampullary region (changes bilateral in 18 cases, unilateral in 11).

2. Tubes closed in the same area (isthmus or beginning of the ampulla) with an irregular or ragged contour at the point of occlusion (bilat. 4, unilat. 1 case).

3. Tubes with multiple strictures in the ampullary or isthmic region (bilat. 7, unilat. 14).

4. Moderately dilated tubes with no mucous membrane relief in the ampulla (bilat. 1, unilat. 4).

5. Dilated tubes with irregular hypertrophic mucous membrane relief in the ampulla (bilat. 6, unilat. 3).

6. Dilated tubes with hypertrophic longitudinal regular mucous membrane relief in the ampulla (bilat. 17, unilat. 4).

7. Slightly or moderately dilated tubes with ragged irregular contours and irregular contrast defects in the ampulla (bilat. 6. unilat. 4).

A water-soluble contrast medium was used because it gives a more detailed study than the oily mediums. Due to the low surface tension of the aqueous medium small fistulas and recesses are filled and also it is miscible with any tubal content that may be present.—*Mary Frances Vastine, M.D.*

AYRE, J. E. Cytologie et histologie, deux méthodes complémentaires pour le diagnostic du cancer utérin. (Cytology and his-

tology, two complementary methods for the diagnosis of uterine cancer.) *Presse méd.*, Oct. 18, 1950, *58*, 1144-1146.

The author describes his method of detection and diagnosis of early cases of uterine cancer. It is performed on symptom-free patients. It consists in obtaining smears from the cervix at the junction of the glandular mucosa and the stratified mucosa. This is done by means of a special wooden spatula. The instrument is designed in such a way that a scraping of the entire circumference of the cervix can be obtained. A first smear is taken, which contains mostly desquamated cells and mucus. A second scraping is then performed obtaining cells immediately underneath the desquamated epithelium. This is the smear that yields the most valuable information. In many cases this is supplemented by a ring biopsy of the cervix. The cells are obtained closer to their origin, and thus the method is far superior to aspiration of vaginal secretions. The smears are stained according to Papanicolaou's method.

The various cells are classed into three stages.

Stage 0—Normal cells

Stage 1—Inflammatory cells
- A. Merely hyperactive.
- B. Hyperplasia with some tendency towards precancerous degeneration.

Stage 2—Anaplastic cells of the precancerous cellular complex
- A. Minimal, to be kept under observation.
- B. Maximal, surgical treatment to be considered.

Stage 3—Cancerous cells
- A. Pre-invading type.
- B. Suspicious cells with maglinant characteristics, but to be confirmed by histology.
- C. Malignant cells.

Pre-cancerous cells are those which exhibit some inflammatory as well as some malignant characteristics. They are not reversible and will often go on to degenerate into cancer. Seven criteria are given.

1. A persistently high count of keratinized cells.
2. Early atypical keratinized cells.
3. Cellular gigantism.
4. Abnormally large hyperactive hyperchromatic nuclei.
5. Multiple or polycyclic nuclei at all levels of the stratified epithelium.
6. Hyperplastic basal cells.
7. Perinuclear halo often found in cells.

The method has been used since June, 1945, on 7,830 women, 3,605 of whom were patients from the gynecological department of the Royal Victoria Hospital, Montreal, and 4,225 others who were outpatients. Most of them were asymptomatic. The accuracy of the method was extremely high in cancer of the cervix, but it was less reliable in cancer of the fundus.

The author suggests the method not only as highly accurate for diagnosis, but as a good means of detection in symptom-free patients. It is true that the interpretation of such smears requires the help of a well trained cytologist. However, the smears can be screened out by adequately trained technicians who easily recognized normal smears from the abnormal, which are then studied by one cytologist. A large number of smears can thus be studied daily.—*J. P. Jean, M.D.*

Kasdon, S. C., Fishman, W. H., and Homburger, F. Beta-glucuronidase studies in women. 2. Cancer of the cervix uteri. *J.A.M.A.*, Nov. 11, 1950, *144*, 892–896.

This report is concerned with an attempt to obtain information and insight into the significance of increased beta-glucuronidase levels in cancer of the cervix uteri, one of several instances in which malignant tissue has been found rich in this enzyme. The investigators studied the cervical cancer tissue beta-glucuronidase and its relationship to the factors which alter enzyme activity levels in the vaginal fluid and in the cervical tissues.

Beta-glucuronidase levels were studied in 35 women with untreated primary genital cancers and 39 women with treated primary genital malignancies. Women before the menopause with untreated cancer of the cervix were found to have vaginal fluid beta-glucuronidase levels similar in range to those found in women beyond the menopause with or without cervical cancer. The value of the vaginal fluid beta-glucuronidase in the group of women in the premenopausal series with cervical cancer exceeded that found in the mid-menstrual period of normal control women. For this reason a limited selection test for carcinoma can be established using these facts as a base. Women in the following groups must be excluded: (1) hysterectomy; (2) purulent vaginitis; (3) postmenopause; or (4) amenorrheic conditions, since in all these conditions the vaginal fluid beta-glucuronidase activity is increased. The specimens must be taken in the menstrual midcyle since normal women have a higher vaginal fluid beta-glucuronidase level frequently a week before and a week after the menses.

The authors were unable to find any prognostic significance in either tissue or vaginal fluid beta-glucuronidase values in irradiated cervical malignancy. The malignant areas after irradiation, which were identified by the residual ulceration, continued to possess abnormally high beta-glucuronidase levels. Irradiation did not decrease the beta-glucuronidase activity of the irradiated tumor tissue.

The authors believe that the major source of the vaginal fluid beta-glucuronidase found in the blind vaginal pouch without disease is the fluid arising from the vaginal mucosa and from the leukocytes.—*F. J. Rigos, M.D.*

GENITOURINARY SYSTEM

HARLIN, HARRISON C., and ATKINSON, H. D. Ureteral diverticulum. *Urol. & Cutan. Rev.*, Sept., 1950, *54*, 526–531.

Ureteral diverticula may be congenital or acquired. A congenital diverticulum is defined as an oval or round extra-ureteral sac containing all of the ureteral coats and communicating with the ureteral lumen through a stoma. A false diverticulum is composed of only mucous membrane and a fibrous tissue wall. This latter type of diverticulum may occur following a stricture, stone or previous operation.

The authors were able to find 18 cases of true congenital diverticulum and add 1 in this report. This was an incidental finding at the time of a total cystectomy for carcinoma of the urinary bladder.

True diverticulum of the ureter is to be distinguished from a blind ending bifid ureter. The latter structure has a course somewhat parallel to the normal ureter and a length more than twice its diameter.

The authors tabulate pertinent facts concerning both the congenital ureteral diverticulum and the acquired ureteral diverticulum.

A good bibliography is attached.—*G. W. Chamberlin, M.D.*

SURRACO, LUIS A., and LOCKHART, JORGE. El problema de las ectasias pielorrenales; las hidronefrosis; su tratamiento. (The problem of pyelorenal ectasias; the hydronephroses; their treatment.) *An. Fac. de med. de Montevideo*, Oct.–Dec., 1949, *34*, 1199–1262.

The authors study the complex problem of pyelorenal hydronephrosis as differentiated from ascending hydronephrosis. In considering the etiological and pathological interpretations of the disease historically four periods may be distinguished: the anatomoclinical, the pyelographic, the pyeloscopic and the present period. The first period was dominated by the anatomomechanical concept, the second by the dynamomechanical concept and the third period by the purely dynamic concept of the disease. The fourth or present period is characterized by an attempt to determine clinically the cause rather than the amount of the urinary retention and especially the reaction of the distended parts once they have been evacuated. This necessitates the clinical coordination of functional tests with the findings of instrumental explorations in various positions, such as dorsal decubitus, Trendelenburg position, and, above all, in the erect position, and with the immediate as well as late functional and anatomic results obtained from surgical intervention.

The authors discuss in detail the role (a) of the anatomic factors (sphincters and pseudosphincters); (b) of the physiopathology of the ureteral sheath, and (c) of the tonus and kinesia of the ureteral wall which are under the influence of the sympathetic nerve system. The situation is compared to that seen in other organs showing a similar type of dilatation, as, for example, in megacolon, congenital pyloric stenosis, cardiospasm and congenital stricture of the vesical neck (Fig. 1). In all of these the anatomoclinical syndrome is characterized by the following triad: (1) congenital origin; (2) increase in the size of the cavity with dilatations, distentions or segmental retentions; and (3) hypertrophy and hyperplasia of the mucosa, submucosa, muscularis and sphincters. The name of pyelorenal syndrome is coined for the designation of this type of ectasia of the kidney pelvis.

In discussing the various roentgenologic methods of examination the authors state that these are of definite value since they permit (a) the visualization of the anatomic alterations due to the pelvic or pyelorenal ectasia; (b) the demonstration of the mechanical or dynamic causes of the ectasia, such as foreign bodies (calculi), nephroptosis, tortuosity, angullation, and bands of the ureter, although the presupposed role of the polar arteries, which by many investigators were considered as the primary cause

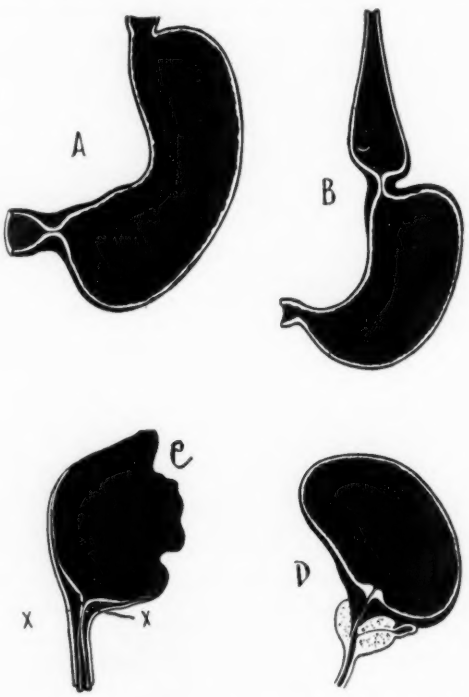

FIG. 1 (Surraco and Lockhart) (*A*) Pyloric syndrome of infant (congenital pyloric stenosis). (*B*) Esophageal syndrome (cardiospasm). (*C*) Pyelorenal syndrome of hydronephrosis (pyelectasis). (*D*) Vesical neck syndrome of childhood (congenital stricture of vesical neck). (Reproduced by permission from the article by Surraco and Lockhart, *An. Fac. de med. de Montevideo*, Oct.-Dec., 1949, *34*, 1199–1262.)

of the process, has been greatly overemphasized; and (c) the establishment of therapeutic criteria.

Excretory urography gives important information in regard to the functional state of the two kidneys but does not solve unequivocally the double problem of retention and dilatation, since often delayed excretion occurs without the presence of hydronephrosis. Likewise, it is of restricted value, notwithstanding the ectasia, when retention is absent, when the cavities are so dilated that they produce a barely visible shadow, and when the kidney exhibits a greatly decreased power of concentration. It is of no value whatsoever in evaluating the process of pyelocalyceal reabsorption.

By using retrograde urography, more accurate information is gained as to the state of the ectasia, the dynamic reactions and the process of the pyelocalyceal reabsorption. The procedure, however, is not without danger. Great care must be taken to completely withdraw the opaque medium in simple retentions and, above all, in distended pelves of the kidney so as not to produce pyelonephritis, which may require emergency intervention or may lead to uncontrollable infectious sequelae.

Not infrequently an exact diagnosis can be made only at the time of operation with the kidney in hand.

The treatment is discussed at length and the authors' personal procedures are described.—*T. Leucutia, M.D.*

Ericsson, N. O., and Lindbom, A. Intravenous urography in renal tuberculosis. *Brit. J. Urol.*, Sept., 1950, *22*, 201–207.

The writers believe that retrograde pyelography has several disadvantages. When cystoscopy is performed in the presence of tuberculous cystitis, the risk of aggravation of cystitis is great (11 per cent in the writers' study of cases). They also believe that cystoscopy is contraindicated in male patients with prostatitis.

Repeated ureteral catheterization may cause an injury of the ureteral mucosa, in which the tubercle bacilli may be inoculated and result in tuberculous stricture. Several such cases were found by the authors.

A pyelovenous reflux cannot be absolutely prevented in retrograde pyelography, even if injection is made very gently. They have seen 1 case where retrograde pyelography was followed by miliary tuberculosis.

The disadvantages of retrograde pyelography listed above are some of the reasons why the writers prefer intravenous urography. In addition, excretory urography is more physiological in studying the function of the kidneys and the ureters.

The writers give the main points of their technique for intravenous urography. Excellent roentgenographic reproductions are presented.

They have examined 154 cases of renal tuberculosis with 173 tuberculous kidneys, and in all but 1 they found changes in the kidneys visible on the roentgenograms. In 80 cases the changes were considered to be typical of tuberculosis and in 61 additional cases the possibility of tuberculosis was suggested. In 12 cases the changes were not conclusive, and the diagnosis was established only after bacilli were found in the urine. In 1 case with normal intravenous urography, repeated retrograde pyelography was necessary to reveal the presence of a lesion. The specimen showed only small tuberculous foci in the kidney pelvis covered by intact epithelium, but of a squamous type.

The roentgenographic changes noted were:

A. *Kidney.* Calcifications, 71 cases. Hydronephrosis, even slight, 56 cases. Changes in the calyces (strictures in 65 cases, destruction in 77). Poor contrast density generally in calyces and pelvis in 63 cases and locally in 46 cases. Signs of perinephritis indicated by blurring of the kidney contour either totally or locally, 29 cases.

B. *Ureter.* The ureters could be partly or totally visualized in 123 cases (80 per cent), 67 of which showed changes. Dilatation was observed in 63 cases, stricture in 6 cases, and a ragged contour in 10 cases. In 41 cases the changes in the ureters were compared with the findings at operation and postmortem examination. In 38 of these, changes were found which were compatible with the roentgenographic findings. In 3 cases no changes were seen at operation.

To judge the normal variations in the width of the ureters, films of 170 normal cases were examined. In only 2 of these cases could any appreciable widening of one of the ureters be observed. This indicates that the ureteral dilatation described is truly a part of the pathological change incident to tuberculosis in the kidneys.

The dilatation of the ureters is the earliest sign of ureteritis, and in some cases is caused by diffuse tuberculous ureteritis. In most cases, however, it is presumed to occur through a loss of tonicity from a localized specific infection. In naked eye or microscopic examinations of surgical specimens it is common to find a chronic inflammatory reaction without signs of tuberculosis in the ureter. This is, in the writers' opinion, the cause of the frequent and early healing of the ureteritis after nephrectomy without total ureterectomy.

The bladder was in most cases not especially examined. However, in 7 cases of unilateral renal tuberculosis a swelling of the interureteric ridge of the affected side was noted. In 4 of these cystoscopy had been performed, and in each case the swelling around the orifice of the ureter had been noted. The swelling of the interureteric ridge without the presence of a ureteral calculus suggests an inflammatory process in the ureter. If especially looked for, this finding may be of value in differentiating between tumor and inflammatory disease of the kidney.

The writers' summary follows:

"Intravenous urography is the best method of

X-ray examination in renal tuberculosis. With a perfected technique it is possible in nearly all early cases, where the kidney function is not considerably impaired, to obtain quite as good and sometimes better visualization of the changes than with retrograde pyelography. By intravenous urography it is also possible to study the excretory function of the kidneys. The risks of retrograde pyelography should be avoided.

"The ureters were visualized with intravenous urography in 80 per cent of our cases, and they showed pathological changes in more than one half of these. The commonest sign is ureteral dilatation. This dilatation is the earliest sign of ureteritis, and may, in some cases, be due to a loss of tonicity caused by a non-specific inflammation accompanying the tuberculous process in the kidney. Swelling of the interureteric ridge may prove to be a sign of ureteritis and possibly an aid in the diagnosis of renal tuberculosis." —*R. F. Niehaus, M.D.*

BEARE, J. BYRON, and WATTENBERG, CARL A. Excretory urography versus retrograde urography; a ureteral compression technic. *Arch. Surg.*, Sept., 1950, *61*, 568–581.

The authors obtain a higher per cent of diagnosable excretory urograms using a compression technique which they describe in detail.

Attention is directed to use of excretory urography as a reliable test for renal function as well as the recognition of congenital anomalies.

Retrograde studies are used to supplement the information obtained from excretory studies and are always carried out where a renal tumor is suspected. —*A. E. Imler, M.D.*

HERRMANN, GERHARD. Indikation und Technik der retrograden Pyelographie. (Indication and technique of retrograde pyelography.) *München. med. Wchnschr.*, Sept. 15, 1950, *92*, 921–925.

Retrograde pyelography represents the final diagnostic means in urology. Because it is not entirely without danger, it was used in less than 10 per cent of all urological patients; cystoscopy and excretion urography gave satisfactory diagnostic answers in all others.

Only a unilateral retrograde pyelogram is done at one session, mostly because of the danger of infecting normal kidneys by the procedure. That is especially true in tuberculosis.

It is understood that the procedure requires some surgical technique in all cases. The ureteral catheter is large enough to occlude the vesicular opening of the ureter and is introduced only for a distance of 2 cm. In this way a ureterogram is obtained which is usually not the case when the tip of the catheter is in the kidney pelvis. Diodrast (perabrodil) 35 per cent is used as contrast material. Usually 3–4 cc. only is necessary, introduced by gravity not by injection. The catheter is left in until the films are available. Occasionally, when a small stone or a papilloma is not demonstrated, oxygen is injected after the contrast medium has been removed.—*H. W. Hefke, M. D.*

ALLEN, DAVID H., BERG, OWEN C., and ROSENBLATT, WILLIAM. Lymphosarcoma of the kidney; a case report and description of roentgen findings. *Radiology*, Nov., 1950, *55*, 731–735.

The authors report a case of bilateral diffuse renal lymphosarcomatosis in which the correct diagnosis was considered before death of the patient.

The patient had an infiltrating lesion in the rectum diagnosed as lymphosarcoma. A year later his abdomen became painful and a movable mass was palpated in the right upper quadrant.

Intravenous urography showed delayed excretion of contrast medium in poor quantity. The renal shadows were greatly enlarged and there was a thickening of the renal cortex. The calyces and infundibula were greatly elongated and slightly enlarged.

On first inspection the picture closely resembled polycystic disease, but further observation failed to disclose the usual calyceal deformities and therefore diffuse neoplastic infiltration from lymphosarcoma was suspected.—*E. E. Seedorf, M.D.*

DEDERICK, GERALD F., JR., MILLS, STEPHEN D., and JUDD, EDWARD S., JR. Adrenal neuroblastoma with metastasis to cervical lymph nodes: report of case. *Proc. Staff Meet., Mayo Clin.*, Oct. 25, 1950, *25*, 618–624.

"Swelling of the neck and fever" were the presenting synptoms in this case of adrenal neuroblastoma in a two and a half year old white girl. Treatment over a three month period consisted of supportive therapy, antibiotics, and two courses of roentgen therapy. Since there was no improvement, a biopsy of the cervical lymph nodes was carried out. This procedure, because of the extent of the lesion, required a modified neck dissection. The pathologic report was that of metastatic neuroblastoma to the right cervical lymph nodes and right parotid gland.

Examination at this time disclosed no enlargement of additional lymph nodes but a mass was palpable in the left upper abdomen. Roentgenologic studies showed irregular areas of rarefaction in the distal ends of the femurs, the proximal portion of the left tibia and in the shaft of each humerus, in addition to a mass above the upper pole of the left kidney which was considered to be a primary neuroblastoma. Further roentgen therapy was given to the cervical area and abdomen without avail. The child died nine months after initial admission.—*S. H. Fisher, M.D.*

LYNCH, JAMES. Functional tumor of adrenal cortex in male child. *J.A.M.A.*, Nov. 11, 1950, *144*, 921–923.

The case presented is that of a six year old white

boy who, for 3½ years, exhibited increasing secondary sex characteristics. All laboratory studies were negative excepting for an increase in the excretion of urinary 17-ketosteroids (19.0 mg. in 24 hours).

Roentgen studies disclosed a normal sella turcica and chest, a hand and forearm bone age of twelve years, and an abnormality in the region of the right kidney. Intravenous urography showed the right kidney to be 5.0 cm. lower in position than the left and a soft tissue mass was noted above the upper pole. Roentgen studies made after perirenal air insufflation disclosed a discrete rounded shadow of increased density 5.0 cm. in diameter above the upper pole of the right kidney. The left kidney appeared normal.

Bilateral adrenal exploration disclosed a normal left adrenal gland and a 34.5 gm., 5.0 cm. tumor above the right kidney. The tumor was well encapsulated, moderately firm and of uniform consistency. The compressed adrenal could be distinguished as a 1.5 mm. layer on the capsular surface.

The pathologic diagnosis of adenoma was made and following removal of the lesion, the child's physical condition became more normal. The excretion of urinary 17-ketosteriods also became more normal.—*S. H. Fisher, M.D.*

Glaser, S. Neoplasms of the epididymis; a review with a report of two new cases. *Brit. J. Urol.*, Sept., 1950, *22*, 178–186.

A good review of the literature on tumors of the epididymis is given. There is a multiplicity of diagnostic labels. A good point is stressed that many differently diagnosed benign tumors may be really one and the same. The author believes that cases variously described as adenoma, myoma, lymphangioma and adenocarcinoma may well be variants of one group.

The benign group is listed as follows:

1. Epithelial—adenoma; cystadenoma; adenomyoma.
2. Connective tissue—lipoma; myxofibroma.
3. Muscle tissue—leiomyoma; fibromyoma; myoma.
4. Endothelial—lympho-endothelioma; angioma; lymphangioma; hemangioma.
5. Mixed—leiomyoma and lymphangioma.
6. Mesothelial—mesothelioma.
7. Teratoma—dermoid cyst; cystic embryoma.
8. Adrenal cortical adenoma.

Operation is the method of choice and the recurrences are few.—*R. J. Reeves, M.D.*

Reynolds, Lloyd R., Schulte, T. L., and Hammer, Howard J. Carcinoma of the prostate gland; results of conservative management. *Arch. Surg.*, Sept., 1950, *61*, 441–448.

This study reports the results of anti-androgen therapy for prolonged periods in 104 consecutive patients with prostatic cancer, of whom 39 had osseous metastases. Diagnosis was confirmed by rectal palpation, roentgenograms, blood chemistry studies, or biopsy. The dose administered originally was 3 mg. diethylstilbestrol per os daily, but this was increased to 5 mg. daily, and, if indicated, increased up to 50 mg. daily.

Where no vesical neck obstruction was present, only the hormone therapy was given. In the presence of urinary obstruction, indwelling urethral catheter drainage was used for varying periods up to four months in conjunction with the diethylstilbestrol. If the patient was unable to void on this regimen, a transurethral resection was subsequently performed, but on a patient who was now in better health, and a better surgical risk.

Of the 104 patients studied, 81 are alive, 18 dead and 5 have been untraced and are considered dead. Twenty-two survived more than five years, making a five year survival rate of 21.2 per cent. The authors believe that his percentage will increase in the future. The average survival time for all patients was 33.8 months, as compared with 21.2 months in a series of 783 patients treated in the pre-"endocrine era." Of 18 patients who died, including 11 with metastases, 9 died from causes other than carcinoma of the prostate. Eight patients failed to respond to the drug, probably because of variation in the histopathologic pattern of the cancer. In only a few cases did relapses occur while the patient was under therapy.—*Gabriel Whiteman, M.D.*

Brendler, Herbert, Chase, William E., and Scott, William Wallace. Prostatic cancer; further investigation of hormonal relationships. *Arch. Surg.*, Sept., 1950, *61*, 433–440.

Although regression of cancer of the prostate and its metastases, and symptomatic improvement has occurred with anti-androgen therapy, these are only temporary. Even in cases where the gonads and adrenals were surgically removed in order to eliminate all the sources of androgens in the body, the tumor was found widely disseminated at autopsy.

It was Huggins' concept that adult prostatic epithelial cells, and the cancer that arises from these cells, undergo atrophy when androgens in the body are reduced. The purpose of this paper is to study the exact role of androgens in the induction or maintenance of prostatic cancer.

A preliminary study of 3 far advanced cases who had subcutaneous implants of 200 mg. pellets of testosterone propionate, showed that 2 of them had symptomatic improvement within two weeks, and in 1 patient there was palpable decrease in the size of the prostate. More careful study was carried out on 3 other far advanced cases, who were given daily injections of 25–100 mg. of testosterone propionate for periods up to two months, and followed for about three months with blood chemistry studies, sternal and perineal biopsies, and roentgenograms. In the 2 cases that had bony metastases, there were consti-

tutional symptoms; these improved, and there was increased appetite with gain in weight. The roentgenograms showed no change in the osseous metastases. The serum acid phosphatase rose in both these patients during the course of therapy but showed no change in the patient that had no osseous metastases; the author suggests the possibility of using testosterone propionate as a diagnostic test for occult bony metastases. In this patient the prostate increased in size and biopsy showed the cells swollen, cytoplasm vacuolated and nuclei deeply stained.

The authors believe that the role of hormones in prostatic cancer may be analogous to their role in breast cancer where there are different indications for the use of male and female sex hormones. Therefore, further investigation into this matter is warranted and patients are to be carefully selected with this thought in mind.—*Gabriel Whiteman, M.D.*

SKELETAL SYSTEM

GOTTLIEB, CHARLES, and BERANBAUM, S. L. Pirie's bone. *Radiology*, Sept., 1950, *55*, 423–424.

Pirie's bone is a small accessory ossicle located on the dorsum of the astragalus just proximal to the astragaloscaphoid joint. Attention is directed to this supernumerary bone which may be mistaken for a chip fracture. Since there is a tendency for this condition to be bilateral, roentgenograms of the opposite ankle are advised.—*A. W. Sommer, M.D.*

MACKMULL, GULDEN, and WEEDER, S. DANA. Bilateral fracture of the humeral heads; case with fractures of the anatomical and surgical necks of the humeri due to convulsion. *Radiology*, Nov., 1950, *55*, 736–739.

Without prodromal symptoms a white male, aged fifty-three, with hypertension had a convulsion lasting thirty seconds. During this episode his arms were flung violently back and forth. Subsequent roentgenograms showed bilateral fractures of the surgical and anatomic necks of each humerus. Six months later the fractures had healed with some deformity, but function of the arms was good.

There is a review of the literature in regard to fractures induced by convulsions and a discussion of the possible causes responsible for the fractures described by the authors.—*E. E. Seedorf, M.D.*

ARDEN, G. P., and WALLEY, G. J. Treatment of intertrochanteric fractures of the femur by internal fixation. *Brit. M. J.*, Nov. 11, 1950, *2*, 1094–1097.

The authors report their results in 37 cases treated by operation and nailing out of 43 consecutive fractures of the intertrochanteric area. The operative treatment of such injuries is advocated for the following reasons: (1) early ambulation; (2) more accurate and stable reduction of the fracture; (3) improved final function; (4) fewer general complications; (5) shorter hospital stay and quicker turnover; (6) lower mortality.

The operation was performed according to standardized methods, by using guide wires through the base of the trochanter into the head of the femur, checked by roentgenograms, to indicate the direction and depth of the nail. No external support for the leg was employed and physiotherapy was begun within twenty-four hours postoperatively. Penicillin was given supportively and patients were encouraged to be up within twelve days in a sitting position and were allowed to walk with crutches within fourteen days but not, of course allowed to bear weight. They were kept in the hospital for a period of four weeks and the average satisfactory union was demonstrated roentgenographically eleven weeks after injury. Follow-up on these cases showed, about the usual statistical results with a two year period giving a fair degree of satisfaction in most instances. There were no totally unsatisfactory results although 5 patients died while in the hospital.

It is the authors' opinion that the operative treatment of these fractures offers the advantages stated above. They do not feel that the mortality is lowered or that the results are necessarily any better as far as reduction is concerned.—*A. J. Present, M.D.*

HYDE, JOHN S., and RICHMOND, JULIUS B. Vitamin D intoxication in a child with rheumatoid arthritis. *Am. J. Dis. Child.*, Sept., 1950, *80*, 379–389.

The authors observed the effect of large doses of vitamin D in a girl twelve years of age with rheumatoid arthritis. Daily doses of 100,000 to 150,000 U.S.P. units of a proprietary irradiated ergosterol product were given for five and one-half years. Subsequent development of anorexia, vomiting, polydipsia, polyuria, nocturia, calcification of blood vessels, periarticular soft tissue, conjunctivas and corneas, hypertension, hypertensive retinopathy and renal insufficiency occurred. After the discontinuance of vitamin D therapy, some amelioration of her symptoms was noted, but there was no significant improvement in renal function after two years of observation, indicating irreversible kidney damage.

The authors suggest that the probable sequence of events in cases of prolonged administration of large doses of vitamin D is increased calcium absorption, increased serum calcium level, decreased parathyroid activity, decreased urinary phosphorus excretion, increased serum phosphorus level, supersaturation of the blood with respect to calcium phosphate and precipitation of the calcium at abnormal sites. Roentgenograms may show bony atrophy and destruction from hypervitaminosis D. Calcium deposits may be seen in the kidneys, bronchi and alveoli, gastric mucous membrane, blood vessels

and periarticular tissues. It is suggested that intoxication from the administration of massive doses of vitamin D is more widespread than the reports in the literature would appear to indicate, for it may masquerade as renal disease.—*R. S. Bromer, M.D.*

Hadley, Lee A. Accessory sacroiliac articulations with arthritic changes. *Radiology*, Sept., 1950, *55*, 403–409.

Accessory sacroiliac articulations are common, occurring in 10 to 36 per cent of studied articulated specimens. They occur most frequently between the posterior superior iliac spine and the sacral tubercle lateral to the second posterior sacral foramen. The anteroposterior or posteroanterior roentgenogram shows the line of the joint extending superiorly and medially from about the midpoint of the anterior margin of the sacroiliac joint. Thinning, irregularity, sclerosis, and ankylosis may occur in this accessory joint and may explain some cases of low back pain.—*M. B. Goodwin, M.D.*

Kuhns, John G., and Potter, Theodore A. Nylon arthroplasty of the knee joint in chronic arthritis. *Surg., Gynec. & Obst.*, Sept., 1950, *91*, 351–362.

The authors are of the opinion that nylon arthroplasty is indicated in the following conditions:

1. Bony ankylosis of the knee in the presence of quiescent arthritis when the hip joints have a fair range of motion. If the hips are also ankylosed they should be made movable before operation is contemplated on the knee joint. When both knees are ankylosed they can both be operated upon but at least two years should elapse before the second knee is operated upon. In this way almost normal strength will be present in the first knee which is usually severely taxed when the patient begins to walk after the second operation.

2. In destroyed joints which will not permit painless weight bearing with support. The articular damage is always much more severe than clinical and roentgen examinations suggest. In a number of these joints the operative procedure contemplated was synovectomy or removal of spurs. In all instances, panus, erosions of articular cartilages, very irregular articular surfaces and widespread intra-articular adhesions have left no other satisfactory surgical procedure than nylon arthroplasty.

3. In severe osteoarthritis, primary or secondary, which has not responded to conservative orthopedic measures. To date the authors have reserved the procedure for patients under sixty years of age who are in excellent physical condition. This work has been restricted to a hospital devoted to chronic arthritis. Arthroplasty is probably not indicated as a primary procedure after acute trauma.

Summary. A useful range of painless motion can be obtained in knees ankylosed or destroyed by chronic arthritis. Knees with fibrous adhesions and severe interarticular derangement function better with nylon interposition than with simple synovectomy and débridement alone. No extensive reshaping of the articular surfaces is desirable. It is never necessary to lengthen the quadriceps tendon in order to secure flexion. The nylon membrane which is interposed should be carried over the edges of the femoral condyles and over the full extent of the quadriceps pouch to prevent the formation of adhesions. The postoperative care with the prevention of complications and the early and prolonged use of physical therapy are essential to the success of this procedure.—*Mary Frances Vastine, M.D.*

Pretl, Karl. Ueber das sogenannte eosinophile Granulom des Knochens und seine Beziehungen zur Hand-Schüller-Christianschen Krankheit. (So-called eosinophilic granuloma of the bones and its relationship to Hand-Schüller-Christian disease.) *Wien. klin. Wchnschr.*, Nov. 10, 1950, *62*, 841–845.

The author presents 2 cases of eosinophilic granuloma of the bones. Summarizing the literature, he finds that most patients with this disease are children and young adults. More males than females are affected. Usually, there is pain and sometimes slight fever, and fluctuant swelling. The bones involved most frequently are skull, pelvis, ribs, and long bones. Roentgenologically, there is an oval-shaped osteoclastic area similar in appearance to that seen in bone cyst but without completely sharp borders and without sclerosis along the margins. Frequently, periosteal reaction is noted. The areas enlarge rapidly so that the possibility of sarcoma (particularly Ewing's sarcoma) is considered. In about one-fourth of the cases, multiple areas are noted. Functional disturbances and spontaneous fractures may occur. Also, there may be extension of the lesion into the regional soft tissues, even the brain.

Blood examination frequently shows a distinct eosinophilia, sometimes up to 20 per cent, and sometimes there is a slight monocytosis. However, the eosinophilia is often absent in the early and end stages of the disease.

The course of the disease is usually benign, more frequently chronic. The processes may heal spontaneously by formation of connective tissue and later even by the appearance of new bone. Therapeutically, curettage or roentgen therapy, or both, must be considered. Radical surgical excision is not advised. Usually, biopsy followed by roentgen therapy (150 to 200 r per treatment for a total dose of 1,500 to 2,000 r) is adequate.

The diagnosis can be established accurately only by histopathological study. The etiology of eosinophilic granuloma is unknown. There is disagreement as to whether the lesion is inflammatory or neo-

plastic in nature. The rich inflammatory histopathological picture suggests the possibility of a virus disease. All bacteriological studies so far have been of no avail.

In the literature, there are case reports of extraosseous lesions of eosinophilic granuloma, particularly in lymph nodes. Also, lesions have been described in the skin, lungs, liver, kidneys, brain, and gingiva. Several American authors believe that eosinophilic granuloma is merely one of the stages of Hand-Schüller-Christian disease and Letterer-Siwe disease. According to this view, Letterer-Siwe disease is the most acute and serious manifestation with slight or no deposition of lipoid, Hand-Schüller-Christian disease is a chronic form with lipoid granulomatosis, and eosinophilic granuloma is the benign type which usually heals. Thannhauser considers eosinophilic granuloma as a monosymptomatic form of a systemic granulomatous disturbance of Hand-Schüller-Christian disease and not as a separate clinical entity. Jaffe and Lichtenstein (1947), however, believe that eosinophilic granuloma should be considered as a clinical entity, a benign process, separate from the two others mentioned above, which usually end fatally. Dill has described 2 cases of eosinophilic granuloma associated with diabetes insipidus. The diagnosis was based primarily upon the presence of many xanthoma cells. It is known, however, that these cells may occur in the second stage of eosinophilic granuloma as well as in Hand-Schüller-Christian disease. Accordingly, Dill's cases probably should be considered as instances of Hand-Schüller-Christian disease.

The author suggests that allergy may be a possible etiological factor in eosinophilic granuloma. The relationship of trauma to this disease should also be considered. Trauma may bring forth a response of the tissues so that later irritation may produce a pathological reaction.—*Samuel Richman, M.D.*

HENDERSON, EDWARD D., DAHLIN, DAVID C., and BICKEL, WILLIAM H. Eosinophilic granuloma of bone. *Proc. Staff Meet., Mayo Clin.*, Sept. 13, 1950, *25*, 534–541.

The authors studied 14 cases of lipoid granulomas of the bones of the trunk and extremities in an attempt to discover valid diagnostic criteria other than those gained by clinical observation by which to distinguish eosinophilic granuloma of bone from Hand-Schüller-Christian disease. The age incidence in both groups was about equal. Severe constant pain corresponding to the location of the bone lesion was the presenting complaint in all cases in which the disease was classified as eosinophilic granuloma. It is relatively easy to determine by microscopic examination that a given lesion should be classified in the group which includes eosinophilic granuloma, Hand-Schüller-Christian disease or Letterer-Siwe disease. On the other hand, differentiation within this group based on the microscopic details of biopsy may be impossible. Biopsy in this type of case should not be abandoned for it will permit the differentiation of other lesions such as malignant tumors which may mimic lipoid granulomas.

They conclude that eosinophilic granuloma of bone seems to be a clinical entity with an excellent prognosis. They did not find evidence to substantiate the concept that it is an early phase in the life cycle of the Hand-Schüller-Christian syndrome. This diagnosis should probably be made only in cases in which no visceral lesions and not more than two bone lesions are present at the same time. If there is any of the classical triad of exophthalmos, diabetes insipidus and multiple lesions of the skull or if visceral lesions are present, there is a more grave prognosis and Hand-Schüller-Christian disease should be diagnosed. Histopathologically the latter diagnosis is possible only if many foam cells or lipophages are present, but their absence does not rule out this condition.—*A. E. Childe, M.D.*

COVENTRY, MARK B. The differential diagnosis of malignant bone tumors. *Ann. Surg.*, Nov., 1950, *132*, 888–898.

The author has reviewed the recent advances made in the over-all knowledge of bone tumors in the past ten years and lists some of the more important contributions as follows:

1. The development and interpretation of the sedimentation rate of erythrocytes.
2. The utilization of the bone marrow biopsy.
3. The entire subject of tumor cytology and its value when used in conjunction with needle biopsy.
4. The application of a grading (Broders') of degree of malignancy to bone tumors.
5. Further microscopic differentiation of tumors, such as osteoid osteoma, eosinophilic granuloma and reticulum cell sarcoma.

The author stresses that biopsy itself is not 100 per cent accurate for the following reasons: (1) the tumor may have been treated previously by irradiation, and this may have caused some change in the structure and appearance of the cells; (2) previous removal of a specimen for biopsy may have resulted in infection, hemorrhage, or both, which may confuse the microscopic picture; (3) the surgeon may not have taken a representative section of the tumor or may miss the main substance entirely; (4) the pathologist may incorrectly interpret the tissue given him.

The difficulty of diagnosing bone tumors and the unreliability of diagnosis from roentgenographic findings alone is stressed, as well as the importance of considering all available diagnostic factors. These factors include a careful history, complete physical examination, essential laboratory studies, roentgenograms and, most important, surgical biopsy.—*R. B. Jeffrey, M.D.*

Abrams, Herbert L. Skeletal metastases in carcinoma. *Radiology*, Oct., 1950, *55*, 534–538.

This is a study of 1,000 consecutive cases of malignant neoplasms of epithelial origin in an effort to show the incidence of bone metastases.

An analysis of the incidence of bone metastases was presented in 1940 by Hubing and Mass. At that time their figures showed a higher incidence of bone involvement than was commonly thought to exist. The present series reported by the author shows a higher incidence than the 1940 survey. This increase is possibly due to more thorough examination of the skeleton at postmortem examination but the author believes the actual incidence is even higher.

The common sources of skeletal metastases from carcinoma are given in Table 1.

Table I

Order of Frequency	General Population	Male Population	Female Population
1	Breast	Prostate	Breast
2	Prostate	Lung	Uterus
3	Lung	Bladder	Colon
4	Colon	Stomach	Stomach
5	Stomach	Rectum	Rectum
6	Bladder	Colon	Bladder
7	Uterus	Kidney	Thyroid
8	Rectum	Pancreas	Ovary
9	Thyroid	Thyroid	Lung
10	Kidney		Kidney
11	Ovary		

It is emphasized that in this series there were 373 cases of gastrointestinal cancer in which 11 per cent metastasized to bone. This figure is higher than commonly accepted and radiologists should recognize this fact in the search for primary malignancies after the metastatic deposits have been found.—*C. A. Stevenson, M.D.*

Fodden, John H. The central malignant chondroma of bone. *Canad. M.A.J.*, Oct., 1950, *63*, 362–364.

Two cases of chondrosarcoma of bone are reported. Noteworthy features are the rare selection of the central or cancellous position for the inception within a long bone, and the involvement of the ulna (in 1 case), a bone infrequently disposed to osteogenic neoplasia.

The most frequent site of chondrosarcoma is at the ends of long bones; they are probably of periosteal or tendoperiosteal origin, and their cellular composition is a mixture of hyaline cartilage and cellular fibrous connective tissue, the latter having in some degree a myxomatous component. The growth commonly progresses into the adjacent soft tissues, and bone erosion or invasion of the medullary cavity comes late as compared to the soft tissue invasion. The monograph of Geschickter and Copeland is referred to as the basis of terminology and classification of these tumors.—*C. N. Borman, M.D.*

Bayles, Theodore B., Judson, Walter E., and Potter, Theodore A. Reflex sympathetic dystrophy of the upper extremity (hand-shoulder syndrome). *J.A.M.A.*, Oct. 14, 1950, *144*, 537–542.

The hand-shoulder syndrome, which is considered a reflex sympathetic dystrophy, occurs in a variety of disorders. Any painful disturbance arising in cardiac muscles, articular or ligamentous tissues, blood vessels, nerves or viscera may produce viscero-afferent stimuli which may initiate and perpetuate this syndrome. Three stages of the condition have been emphasized: (1) The initial stage with severe burning pain, swelling of the distal part of the limb and muscle spasm. (2) The second stage with muscle atrophy, flexion deformities and contractures. (3) The third stage with more pronounced flexure contractures accompanied by intense and intractable pain.

The mechanism of the syndrome remains obscure. It is postulated that a vicious, continuous agitation of pain impulses originating from localized tissue disturbances which spread through the "internuncial pool" of neurons in the cord, produce overstimulation and activity across the synapses.

Patients seen in the initial stage of the dystrophy respond to stellate ganglion block with procaine hydrochloride. For those patients who already have trophic changes, sympathetic nerve block was ineffective and sympathectomy was not indicated.

Seventeen patients in various stages of unilateral or bilateral reflex sympathetic dystrophy of the upper extremity are described.—*Francis O'Neill, M.D.*

Nardell, Sydney G. Ollier's disease: dyschondroplasia. *Brit. M. J.*, Sept. 2, 1950, *2*, 555–557.

Ollier's disease, dyschondroplasia, is characterized by the presence of cartilage in the diaphyses of long and short pipe bones as a result of failure of normal ossification of cartilage to take place. There are gradations from small islands of cartilage to large palpable masses of cartilage. In addition, small irregular exostoses are present. These exostoses have, in part, caused confusion between Ollier's disease and Keith's diaphyseal aclasis. In the latter, multiple exostoses pointing away from the end of the bone is the main feature.

The case presented belongs to the Maffucci syndrome. This consists of the characteristic features of dyschondroplasia, mostly on one side of the body, with hemangiomas more or less confined to the op-

posite side. Malignant changes supervened in this patient, as had been observed in other cases.

The patient was thirty-four years of age. He was apparently normal at birth. Swelling of the left hand was first observed at the age of five. He had fractured his left leg eight times while playing football. There was no family history of similar disease. Roentgenograms of the skull were normal. The angular bends of dyschondroplasia described by Jansen were well seen in roentgenograms of the humeri. Little persistent cartilage was present. The left hand contained large nodular masses of cartilage. The carpal bones were normal. The right hand showed Madelung's deformity due to a shortened broad radius with some cartilaginous islands. The iliac bones contained numerous islands of cartilage. The left femur was 30 cm. shorter than the right, was broadened at its distal end with extensive areas of cartilage. The left tibia contained areas of cartilage and irregular small exostoses not pointing toward the ends of the bone. The left foot showed multiple areas of cartilaginous masses. The tarsal bones were more or less normal.

Laboratory studies failed to reveal significant abnormalities. A malignant lymphangioma developed in his right lower extremity. Death ensued following metastases to the lungs four years after surgical intervention.

The author states that 25 per cent of these cases become malignant, and that the average age is thirty-three years.—*F. H. Squire, M. D.*

HOWARD, R. PALMER. Medical aspects of bone disease with particular reference to osteoporosis. *Canad. M.A.J.*, Sept., 1950, *63*, 258–264.

The author discusses the specific metabolic derangements which result in generalized rarefaction of bone. Three conditions which lead to generalized bone demineralization are osteoporosis, osteomalacia, and osteitis fibrosa generalisata. The author uses the schematic diagrams published by Albright[1] to show the physiological differences between the normal bone, osteoporosis, osteomalacia, and hyperparathyroidism with osteitis fibrosa generalisata. This article confines its scope to the discussion of osteoporosis. This condition may be divided into four main groups:

(a) Atrophy of disuse.
(b) Hypercorticoidism.
(c) Senescence.
(d) Gonadal deficiency. "Postmenopausal osteoporosis." The discussion in this work is confined to the latter group.

Although osteoporosis occurs in all women after the climacteric, the process only attains clinical significance in a small percentage. It is assumed that the syndrome was caused by a failure in gonadal secretion of steroids which physiologically cause stimulation of osteogenesis. It has been shown that estrogens or androgens caused a favorable effect on calcium retention. This retention is in the order of 0.2 to 0.4 gm. of calcium per day. In the average adult, assuming that the bones were 50 per cent deficient in calcium, eight years would be required for the replacement of the calcium deficiency. The author believes that this accounts for the evidence of clinical improvement without obvious improvement in the appearance of the bones in the roentgenograms.

Two case histories are presented in detail. There was a rapid clinical response to combined estrogen and androgen therapy. Improvement in the roentgenological abnormalities has not yet been observed. —*W. C. MacCarty, Jr., M.D.*

[1] Albright, F., Bloomberg, E., and Smith, P. H. *Tr. A. Am. Physicians*, 1940, *55*, 298.

PERAZZINI, FEDERICO. Aspetti radiografici della tubercolosi dell'ileo. (Roentgenographic aspects of tuberculosis of the ilium.) *Radiol. med.*, Sept., 1950, *36*, 713–719.

Tuberculous osteitis of the ilium is the least common form of tuberculosis occurring in the bones of the pelvic girdle, where owing to the anatomic characteristics of the spongious and flat bones the specific infection usually appears as a circumscribed lesion.

The author briefly presents 2 cases of tuberculosis of the ilium in which the osseus involvement was quite diffuse. The respective roentgenograms are reproduced for the purpose of illustration.

The following observations were made:

(1) Diffuse tuberculosis of the ilium is characterized clinically by an insidious onset leading slowly, over a period of years, to the symptom complex of coxalgia or sacrocoxalgia which, however, is never very severe.

(2) There is a marked disparity between the rather mild clinical manifestations and the extensive osseous involvement as demonstrated on the roentgenograms.

(3) The roentgen appearance is not typical. In both cases the process involved the entire ilium and extended into the sacrum of the affected side. There were numerous cavities of varying size separated in some places by a very thin osseous wall and having become confluent in others. In the sacroiliac region, where the bone is more compact, the cavities were much smaller. The osseous zones or walls between the cavities showed a bizarre mixture of bone condensation and osteoporosis. The picture in its entirety resembled that of a sponge or a jagged coral.

The differential diagnosis includes the various cystic and destructive lesions of the bone and especially echinococcus cyst. This latter is distinguished through the fact that it never provokes new bone formation, and when the involvement is as extensive as was in the author's 2 cases, marked deformity or spontaneous fracture of the ilium is usually seen. The

accessory laboratory tests, and eventual biopsy, of course, help in establishing the final diagnosis in the majority of instances.

Considering that in diffuse tuberculosis of the ilium the destructive process develops mainly in the spongious part of the bone, the author is of the opinion that the involvement of the sacroiliac articulation, and less frequently of the hip, must be regarded as a secondary manifestation.—*T. Leucutia, M.D.*

Blood and Lymph System

Leriche, René. Des calcifications artérielles. Mécanismes et traitement. (Arterial calcifications; mechanisms and treatment.) *Presse méd.*, Oct. 4, 1950, *58*, 1045–1046.

Until now, calcification of the media, such as that described by Mönckeberg, has been without clinical correlation. It has been known only that the calcification can be demonstrated in the lower extremity, and occasionally in the aorta to the side of the spine. The practice of arteriectomy and the common use of aortography now permits a rough outline of certain aspects of the problem.

Calcifications are frequent at the age of forty-five but probably are present much earlier than this and are unrecognized because they are asymptomatic. The plaques are often multiple and are not ordinarily confluent. The calcifications do not interrupt the arterial flow, at least not for a long time. This is the reason there are no symptoms except perhaps for fatigue on long walks. There is no intermittent claudication. One patient was unable to sit very long without severe cramps in an extremity; he had no trouble standing or lying down. Aortography showed a rigid primary iliac artery. At operation, it could be seen that, when the thigh was flexed, the artery formed an elbow above the calcification.

Thrombosis may occur quite late. Muscular degeneration and plaques of endarteritis infiltrated with fat cells precede the calcification. By aortography early calcifications and degenerative lesions without thrombosis have been found probably because the nutrition of the intima has not yet been sufficiently impaired. Extensive calcification may permit the passage of a pulsating blood flow although the latter is reduced. These arterial stenoses without thrombosis may give the roentgenographic appearance of a hiatus, perhaps because the onset is too slow, perhaps because the fluid is not thick enough. It is also important to realize that a rigid vessel may not transmit pulsation and as a result thrombosis may be mistakenly diagnosed at operation.

These calcifications are thought by the author to originate either in a local calcific change or on an endocrine basis. The former occurs in relation to local osteolysis. Thus it has been found in association with decalcification of the spine and in chronic rheumatism of the spine, sacroiliac and hip joints. Calcified arteries are found in Paget's disease. When a local cause cannot be established, the possibility of a parathyroid disorder must be entertained. The fact that the blood calcium is normal has no significance since the hyperparathyroid episode may have occurred during birth, following an accident, a slight infection or a metabolic upset, with repeated injury to the media.

In treatment, the author performs arteriectomy or a low ganglionectomy or both in old patients. In those patients between thirty-five and sixty years, he begins with a low lumbar ganglionectomy even if the calcifications are not followed by thrombosis. This may be combined with a simple arteriectomy. If the obliteration is very extensive a vein graft is used. If these measures are not effective, in this middle age group, the author considers that parathyroidectomy is indicated. However, he admits that the follow-up on his cases is not yet long enough to permit evaluation.—*M. L. Sussman, M.D.*

McCarthy, William D., and Pack, George T. Malignant blood vessel tumors; a report of 56 cases of angiosarcoma and Kaposi's sarcoma. *Surg., Gynec. & Obst.*, Oct., 1950, *91*, 465–482.

A comparative survey of 20 cases of angiosarcoma and 36 cases of Kaposi's sarcoma is presented. An attempt has been made to clarify the great confusion existing in the study of malignant blood vessel tumors.

Definite predilections in race, sex and anatomical onset are noted in Kaposi's sarcoma. Among the patients studied 82 per cent were Jews and Italians; 92 per cent were males and 87 per cent had their onset on the extremities. The disease is bizarre or fulminating in females. Similar predilections are noted in the patients with angiosarcoma. There seems to be a racial predispostion as well as a systemic factor, possibly hormonal, in the development of malignant vascular tumors.

Three cases of Kaposi's sarcoma with coexisting lymphoblastoma are reported.

Trauma appeared to be directly involved in the development of angiosarcoma in 3 of the authors' patients. It was suspected as the precipitating factor in 2 additional patients with angiosarcoma of the breast.

Angiosarcoma was observed to develop from irradiated benign angiomas (after a long interval) in 3 patients.

Prompt radical amputation is probably the only curative therapy for angiosarcoma of the extremities.

Roentgen and radium therapy has a definite place in the curative treatment of angiosarcoma of the nasal cavity and paranasal areas. It is indispensable in the palliation of the advanced or inoperable angiosarcomas in general.

The three year cure rate in the angiosarcoma group is 17 per cent; the five year cure rate 9 per cent. Average survival interval was two years six months.

The definitive five year cure rate of Kaposi's sarcoma is 19 per cent. The average survival from time of onset was eight years. However, several patients are alive with the disease from 10 to 25 years.

Two patients are described in the recent literature in whom lymphangiosarcoma originated in the massive arm of postmastectomy lymphedema.

Clinicians are strongly cautioned against the acceptance of the ambiguous term "hemangioendothelioma" which is commonly used to describe a specific type of benign cellular hemangioma in children. The term implies sarcoma and has undoubtedly led to needless radical surgery in many instances. It should be employed only to designate a specific type of angiosarcoma.—*Mary Frances Vastine, M.D.*

Hill, Norman P., and Hawn, Clinton Van Zandt. Plasmacytic leukemia; report of a case. *New England J. Med.*, Nov. 16, 1950, *243*, 769–773.

The case is reported as an example of what might properly be called plasmacytic leukemia since no evidence of discrete nodules or destructive lesions was found to indicate focalization of the type associated with a true multiple myeloma. The case report is that of a fifty-five year old foreign-born laborer who complained of progressive weakness of three and a half months' duration, bleeding from the gums and nose for one week. There had been no hematuria or melena. There had been some low grade fever without chills or other signs of infection and the patient had responded mildly to the administration of penicillin although his weakness progressed. The anemia was reflected in the blood count and the patient was given four transfusions on his first admission and discharged from the hospital. On examination, the outstanding findings were the signs ascribed to anemia, namely pallor of the conjunctivae, ocular fundi and mucous membranes. There was oozing of blood from the gums and clotted blood was seen in each nostril. A few small lymph nodes were palpable in the neck, axillae and inguinal areas. The heart and lungs were negative. The liver edge was palpated 6 cm. below the costal margin in the mid-clavicular line; it was firm and non-tender. The spleen was enlarged to about the same distance below the costal margin and likewise was firm and not tender. The remainder of the physical examination was not unusual. There was a fever of 99.4° F., a pulse of 86 and respirations of 20. Blood pressure was 170/100. The blood count, in addition to revealing an anemia, showed a variable leukocytosis of from 13,000 to 38,000 with some eosinophilia, a predominant lymphocytosis and a plasmacyte count ranging from 22 to 27 per cent. Although there was albumin in the urine there were no Bence-Jones elements. A diffuse skeletal survey failed to reveal roentgen changes. Sternal marrow biopsy revealed a distortion of all architecture with the presence of multiple plasmacytes. These showed a moderate number of mitotic figures and many appeared to be immature. There were a few areas containing islands of fairly normal appearing primordial red and white cells.

The patient was allowed to go home but was soon readmitted (twelve days later) in a moribund condition. He died shortly after admission. The autopsy revealed a generalized pulmonary edema without focal lesions, no localizing cardiac abnormalities and a total absence of destructive lesions in ribs, vertebrae or pelvic bones. The findings of the gastrointestinal tract were not remarkable.

Microscopically the lungs were found to be edematous, as described above, with the alveolar walls containing numerous plasmacytes both within the capillaries and interstitially. A similar infiltration was found in the cardiac musculature and in sections of rib and vertebral marrow. In the spleen the sinusoids and pulp were packed with infiltrating plasmacytes. In the lymph nodes a packing of the vascular channels and sinusoids was seen, this packing with plasmacytes apparently constituting the predominant manifestation in all areas.

It seems apparent then that the clincal features were those of acute or subacute leukemia. No discrete tumor nodules were demonstrated either roentgenographically, on physical examination, or at autopsy.

The authors feel that the case herein presented provides additional evidence for the existence of a true plasmacytic leukemia as a clinical and pathological entity.—*A. J. Present, M.D.*

RADIATION THERAPY

Peirce, Carleton B., and Bouchard, Jean. Role of radiation therapy in the control of malignant neoplasms of the brain and brain stem. *Radiology*, Sept., 1950, *55*, 337–343.

Regardless of the means of treatment, life expectancy in malignant neoplasms of the brain is relatively short. This is true because of the nature and location of these tumors, the obscurity of symptoms and delayed recognition.

Close cooperation between the neurosurgeon and the radiologist and careful observation in the hospital is essential during radiation therapy of these lesions. Accurate localization of tumor and estimate of size is necessary. The initial daily dose of radiation should be relatively small (100 r), and full facilities must be available for relief or unfavorable reactions, particularly excessive intracranial pressure. Hyperthermia, headache, drowsiness, slowing of speech or stupor most be watched for. Irradiation may be begun as soon as the scalp incision is firm, appreciable subcutaneous fluid or edema is reduced and intracranial pressure will permit.

Glioblastoma multiforme, the most malignant of the gliomas, comprises about one-third of all gliomas and one-half of the adult lesions. Growth is rapid and recurrence after operation is to be expected. Proper

irradiation results in a definite increase of the average survival period. A minimum tumor dose greater than 7,500 r is required.

Life expectancy charts based on length of survival after operation and irradiation in the present series indicate the following percentages:

12 months or more, 47.9%
20 months or more, 22.9%
30 months or more, 8.3%

Astrocytoma is a slower growing and relatively less malignant tumor common in the cerebellum in children and the frontal and temporal lobes in adults. Irradiation adds considerably to the life expectancy of these patients. A minimum tumor dose up to 9,000 r is the present goal.

Life expectancy charts based on length of survival after operation and irradiation in the present series indicate the following percentages:

12 months or more, 87.8%
36 months or more, 43.9%
96 months or more, 9.7%

Unclassified malignant gliomas, represented by 29 cases, fall in between the two major types as to degree of malignancy and susceptibility to irradiation.

Astroblastoma, with 3 treated cases, and spongioblastoma, with 2 treated cases, do not permit evaluation of the influence of treatment on longevity.

Oligodendroglioma and oligodendroblastoma are less sensitive to irradiation than medulloblastoma. Total dosage should approach 9,000 r.

Ependymoma and ependymoblastoma arise in the walls of the ventricles. McWhirter considers ependymoma relatively radiation insensitive and ependymoblastoma relatively sensitive. Radiation therapy should be employed in this group.

Hemangio-endothelioma, papillary adenocarcinoma of the choroid plexus and perithelial sarcoma are relatively uncommon and the role of radiation therapy is not conclusive.

Pinealoma is considered insensitive and pinealoblastoma somewhat more sensitive. Medulloblastoma, a tumor occurring in the cerebellum in childhood, is radiation sensitive but shows a marked tendency to recur and a poor prognosis.

Meningioma and meningeal fibroblastoma previously considered resistant are now considered radiation sensitive. Tumor dose of 5,000 r to 6,000 r is advised.—*A. W. Sommer, M.D.*

Leroux-Robert, J., Ennuyer, A., and Calle, R. Traitement des cancers hypopharyngés et laryngo-pharyngés par l'association chirurgie-radiothérapie. (Treatment of hypopharyngeal and laryngopharyngeal cancer by combination of surgery and radiotherapy.) *Bull. Assoc. franç. l'étude cancer*, 1950, *37*, 232–248.

The authors claim to have improved the results of treatment of cancer of the hypopharynx by a combination of surgical and roentgen therapeutic methods. Special surgical techniques are described for excising extensive laryngopharyngeal epitheliomas. One month after operation, a course of roentgen therapy is administered to both sides of the neck through two fields on each side, an upper and a lower. A dose of 3,600 to 4,200 r is given to each field over a period of sixty to seventy days with 180 kv. radiation. Additional therapy, 800 to 1,200 r, may be given if there is persistence of disease. The combined method of therapy is indicated for ulcerated, infiltrated, resectable lesions. More extensive, non-resectable lesions require palliative irradiation. The authors also recommend roentgen therapy alone, without surgery, for small, limited, superficial lesions. If lymph nodes are involved, a radical neck dissection may be included in the original operation, provided the criteria of operability are satisfied.

There were 7 three year survivals without evidence of disease out of 18 cases treated by the combined method. None of these cases had involvement of the lymph nodes at the original examination. There were no statistics for cases with lymph node involvement. —*S. M. Silverstone, M.D.*

Zacherl, H. Die zweckmässige Koordination der chirurgischen und internen Krebsbehandlung mit der Röntgen- und Radiumtherapie. (Coordination of surgical and radiation therapy in the treatment of carcinoma.) *Wien. klin. Wchnschr.*, Sept. 22, 1950, *62*, 717–720.

The results of rather extensive statistical studies show that carcinoma of the female can be treated with approximately equal results by radiation therapy and surgery. This has led to the fact that many gynecologists have given up the surgical treatment altogether.

An increasing interest for the return of surgical treatment in the therapy of carcinoma of the cervix is noticeable throughout the world. This is due to several factors: the modern preparation for surgery by internal and general procedures; the extensive use of transfusion of blood and plasma, before and after surgery; the prevention of postoperative complications; an improvement in anesthesia; and the treatment of secondary inflammation by antibiotics. These factors have lowered the mortality following operation, even in extensive surgery.

The poor results obtained in certain cases of even early carcinoma of the cervix by irradiation, has awakened again the interest in the surgical treatment of such cases. This has led many to believe that the treatment of choice for the operable cases, in Stage I and II at least, remains surgery.

The development of a method which would allow to evaluate the sensitivity to radiation would be of

very great help. Glücksmann found in a large series that radiation sensitivity does not correspond with a greater rate of cure. According to him, the curability depends on the degree of differentiation of the cancer cells. Differentiated even less sensitive types of carcinoma have a better quota of curability than others. The author believes that surgery, followed by postoperative irradiation, should be undertaken in all cases in which this method would not promote a poorer result than irradiation alone. He believes that most patients recover faster following surgery and subsequent irradiation than following irradiation alone, since the destruction of large masses of tumor cells represents a great insult to the body. Surgery, however, should only be undertaken by men who are adequately trained and who are able to do extensive radical procedures. In all other cases, radiation treatment should be preferred. It is not recommended to use surgery in the border line cases in which a recurrence has to be expected in a very high percentage. The question of treatment should not be fixed, but should vary from case to case.

A great improvement represents the recently developed intracavitary roentgen therapy. This makes it possible to lower the usual radiation dosage and is not accompanied so frequently by vesicovaginal and rectovaginal fistulas.

Carcinoma of the fundus of the body shows considerably better results by surgery or surgery and irradiation combined, than by irradiation alone. The use of the intracavitary roentgen therapy in inoperable cases of carcinoma of the fundus directed towards the parametria also has improved the result in those lesions.

Carcinoma of the vagina in best treated by irradiation alone, despite the high number of complications due to fistulas between vagina and bladder and vagina and rectum. The author recommends a combination of surgery and postoperative irradiation for carcinoma of the vulva. He does not believe that extensive surgery is indicated in these cases which affect most commonly old women in a poor general state of health.

Carcinoma of the ovary is best treated by surgery with subsequent irradiation.

Tumors of the ovary, which on superficial examination appear to be inoperable, can often be completely or partially removed surgically.

Radiation sensitivity of tumors of the ovary varies and depends upon the histopathological differentiation, and to a larger degree upon the extent and dissemination of the tumor. The question whether or not postoperative irradiation in an apparently radically operated case should be undertaken or not depends upon the nature of the tumor, and the age of the patient. Arrhenoblastoma and granulosa cell tumors metastasize or recur only rarely. Adequate irradiation, however, is indicated in all those cases in which the surgery was not radical.

The question whether a prophylactic postoperative irradiation is indicated in cancer, as a whole, is undecided. Schinz, in a comparative series of 800 cases, found that those cases which had postoperative irradiation showed a 15% higher five year survival rate than those not irradiated.—*H. P. Mueller, M.D.*

STILLIANS, ARTHUR WILLIAM. By-effects of irradiation on the skin. *J.A.M.A.*, Oct. 28, 1950, *144*, 743–746.

Besides the usual effects of irradiation there are several other skin changes secondary to the action of light on the skin.

The commonest is eczematoid dermatitis superimposed on radiodermatitis; it spreads beyond the limits of the treatment field but yields to local therapy.

A ring of comedos may form about the scar secondary to irradiation for skin tumor.

There are rare cases of erythema multiforme and these apparently heal spontaneously in a few weeks.

There may be condylomatoid lesions, yellowed with a moist surface, occurring in the treated field and disappearing spontaneously in two to three weeks (? overgrowth of granulomatous tissue).

Three cases of squamous papilloma or epithelioma are quoted from Walter as occurring in treated fields shortly after therapy. These were separate lesions and not skin secondaries as shown by biopsy. The lesions were not coincidental skin cancer or roentgen therapy would have cured them and they were not secondary to overdosage. Stillians considers them early radiation effects due to mutation. He presents 1 case with nodule formation after radium treatment of a keratosis and gives a complete pathologic report. The tissue showed "chronic fibrous reaction probably due to repeated inflammatory insults" with capillary hyperplasia and large endothelial cells.—*Martha E. Mottram, M.D.*

COCCHI, UMBERTO. Clinica e terapia del linfoblastoma giganto-follicolare (Malattia de Brill-Symmers). (Clinical course and treatment of giant follicular lymphoblastoma [Brill-Symmers disease].) *Radiol. med.*, Sept., 1950, *36*, 705–713.

The author briefly reviews the pathology, clinical course and treatment of giant follicular lymphoblastoma on the basis of 5 personal observations and some 200 cases collected from the literature.

The treatment of choice is roentgen therapy although surgical removal has led to cure in a few cases with solitary involvement of the spleen or one lymph node area. The value of chemotherapy (arsenic, nitrogen mustard, urethane) cannot be judged as yet but it appears from the cases treated so far that this method will prove of limited usefulness.

As regards the dose, the author states that occasionally he has observed a complete and permanent

regression of enlarged lymph nodes from only 400 r. However, since in such instances the recurrence usually develops increased radioresistance, he recommends that the total dose be raised to at least 3,500 to 4,000 r in all cases, including those which during the administration of the first few fractions of roentgen rays exhibit a high degree of radiosensitivity. The procedure is similar to that used for the roentgen treatment of lymphosarcoma and Hodgkin's disease.

The author determined the suvival rate in giant follicular lymphoblastoma by studying all the cases from the literature which were described in detail. Satisfactory data were secured in 25 untreated and 94 treated patients. Of these latter 71 were treated by roentgen therapy exclusively, 8 by a combination of roentgen therapy and surgery, 5 by a combination of roentgen therapy and chemotherapy, and 10 by surgery alone. The results are tabularly arranged. It was found that the untreated patients died on an average two years and eleven months after the onset of the disease, not a single spontaneous cure being recorded. In the treated group the five year survival rate was 18.3 per cent when roentgen therapy alone was used, 25 per cent when the roentgen therapy constituted an adjuvant to surgery and 30 per cent when surgery alone was used (all early cases). The over-all five year survival rate was 19.4 per cent. In those patients who died, life was prolonged to four years and eleven months by roentgen therapy, two years and four months by the combination of surgery and roentgen therapy and to three years by surgery alone, giving an over-all prolongation of life of four years and six months.—*T. Leucutia, M.D.*

Caldwell, Guy A., and Unkauf, Byron M. Results of treatment of subacromial bursitis in 340 cases. *Ann. Surg.*, Sept., 1950, *132*, 432–442.

This study includes a discussion of the pathogenesis and an evaluation of various forms of treatment of subacromial bursitis. The principal aim of the treatment has been to relieve the acute pain as quickly as possible, and then to preserve motion, or to overcome such adhesions as were already present from the use of heat followed by stretching exercises.

The forms of therapy used were procaine injections, physical therapy, roentgen therapy, incision, and manipulations. Of these forms, roentgen therapy was considerably more effective in relieving the pain and disability than any of the other forms of treatment used. This was true in the acute, subacute, and the chronic forms of subacromial bursitis.—*E. A. Addington, M.D.*

Baclesse, F., and Herlory, G. La roentgenthérapie dans les ostéosarcomes des os longs chez les sujets jeunes (à l'exclusion des tumeurs d'Ewing). (Roentgen therapy in osteosarcomas of long bones in the young [excluding Ewing's tumor].) *Presse méd.*, Oct. 4, 1950, *58*, 1075–1076.

This report concerns 9 patients whose tumors were treated between 1936 and 1947 by roentgen therapy alone or with surgery. There were 6 osteogenic sarcomas of which 3 were feebly osteogenic; 1 osteofibrosarcoma; 2 osteochondromyxosarcomas. Eight tumors were found in the femur and 1 in the tibia. Three patients had suffered a pathological fracture. The aim of this study was to determine how these very malignant tumors could be blocked in their evolution or stabilized so that there is an apparent local cure.

Six patients were treated by roentgen therapy alone; 4 died rapidly with hematogenous metastases; 2 survived fourteen and three years without apparent disease. By contrast, 3 other patients, after roentgen therapy with high dosage, were disarticulated because of trophic disorders. One of these young patients died after a second tumor localization in the opposite femur. The other 2 were apparently cured eight years and five months, and eight years respectively later. The histopathological findings after this therapy were interesting. In the first case, disarticulated four and a half years after therapy, the sarcoma was in full development, even though clinically and roentgenographically the tumor was thought to be stabilized. Evidently irradiation had retarded but had not sterilized the tumor. The patient apparently has been cured by surgery, being free of metastases three and a half years later.

The second case was an osteoblastic sarcoma operated upon two years and eight months after irradiation. There were differing histopathologic opinions, one considering the tumor sterilized, the other not. This indicates the difficulty in interpretation of heavily irradiated and necrotic tissues. This patient is without apparent metastases more than four years after sugery and eight years after roentgen therapy.

It seems, then, that osteosarcomas are very variable, some reacting favorably and others being refractory to irradiation. It is not possible clinically, roentgenographically or histopathologically to prognosticate.

The treatment factors varied as follows: 180 kv., 1 mm Cu. and 2 mm. Al, to 275 kv., 2 mm. Cu and 3 mm. Al. Distance 50–70 cm. Intensity 15–20 r per minute average. Multiple fields adapted to the tumor and the long bone were used, anterior, posterior and laterals. The fields were alternated so that each was treated on an average of every two days. The skin dose did not exceed 4,000 r per field. In the 2 cured cases (14 and 3 years) the approximate tumor dose was 9,100 r and 9,200 r. The tumor dose in the case in which there is dispute histopathologically as to sterilization was 8,500 r. The case which was definitely not sterilized received 6,500 r. Treatment seems best administered over two or three months, perhaps in two or three series with intervening rest

periods. Each field receives 150–200 r per treatment.

The authors conclude that there are types of osteosarcoma occurring in the young, excluding Ewing's tumor, which react favorable to large doses of roentgen rays. It is not possible to distinguish these tumors clinically, roentgenographically or histopathologically. Sometimes the treatments must be followed by surgical amputation.—*M. L. Sussman, M.D.*

MALONEY, G. C. The value of vaginal cytology in observing the progress under radiation treatment of patients suffering from cancer of the cervix. *Am. J. Obst. & Gynec.*, Sept., 1950, *60*, 533–538.

The object of this paper was to find a method whereby radioresistant tumors, unidentifiable, until clinical spread demonstrates their presence, could be recognized prior to extension or metastases.

Material for this study was drawn from the Gynaecological Clinic at the Ontario Institute for Radiotherapy, Toronto General Hospital. All patients under treatment regardless of their clinical classifications were followed. Smears were collected on the initial visit, and again before the initiation of treatment whether high voltage roentgen or radium therapy, and weekly during high voltage roentgen therapy. Smears were also collected at regular follow-up examinations after the completion of treatment.

Out of 120 observed cases, 54 are presented in which the regularity of the collection of smears justifies inclusion.

When the vaginal smear was clear of malignant cells before the twentieth high voltage roentgen treatment and remained negative subsequently, and provided that the clinical course of the patient remained satisfactory, correlation between response to therapy and clinical course of the patient is said to exist. Correlation is also claimed when smears remain positive and the clinical course of the patient is unsatisfactory. Lack of correlation exists when persistent viable carcinoma cells showing no radiation changes on smears are noted and the patient's clinical course is reported as satisfactory or when smears are negative and the clinical course is retrogressive.

The following tables illustrate that when the pretreatment smears were positive, the correlation was absolute, but when the smears were negative, the reverse was true.

TABLE I—STAGES I AND II

Pretreatment smears positive	10
Correlation between vaginal smear findings and clinical course	10
Pretreatment smears negative	3
Correlation	0

TABLE II—STAGES III AND IV

Pretreatment smears positive	30
Correlation existed	20
Correlation percentage	66%
Pretreatment smears negative	11
Correlation existed	1
Correlation percentage	0.9%

Fourteen cases, three in Stages I and II and 11 in Stages III and IV, were disappointing and puzzling. Several good smears from each patient were examined and reviewed. In none was sufficient evidence present to call them positive.

Three cases in Stages I and II were highly undifferentiated anaplastic carcinomas in young women. When first seen the lesions were large and confined to the cervix. Two patients died of their disease eight and ten months after initial diagnosis. Their tumors were probably highly radioresistant and did not exfoliate. The third case was a Stage I tumor. The patient has done well and is apparently free of the disease.

Four patients, all Stage I cases, received 8,400 mg. hr. of radium, half intravaginal and half intrauterine. Four weeks after the application of radium and before onset of their high voltage roentgen treatment, their smears were negative and have remained negative. Three of these patients are alive and well, fourteen to seventeen months later, and show no clinical evidence of disease. The other 6 patients in this group received high voltage roentgen therapy initially and had a clearing of malignant cells in smears after an average of fifteen treatments, when the dose was 1,800 r to the cervix. All these patients were alive and well fourteen to twenty months later.

Eleven cases in Stages III and IV showed positive smears throughout treatment. All are dead of their disease from two to twelve months after commencing treatment or were moribund when last reported.

Ten cases in Stages III and IV showed no correlation. The patients fell into two equal groups. Five revealed positive smears throughout treatment and have made satisfactory clinical progress up to the present. In the 5 remaining cases, the smears became negative and the patients all died of their disease.

Some evidence exists from these findings that vaginal smears have value in assessing the radiosensitivity of the carcinoma of the cervix. Tumors which are radioresistent at an early stage in radiation treatment could be selected and treated surgically. Repeated biopsy of the cervix has been tried and found to be technically impractical.—*S. N. Tager, M.D.*

RADIOISOTOPES

KISIELESKI, WALTER, SVIHLA, GEORGE, and BRUES, AUSTIN M. Preparation of radioac-

tive glass beads. *Science*, Oct. 6, 1950, *112*, 400–402.

A method is described which deals specifically with the production of glass beads containing yttrium^{91}. Beads of comparable activity with Ce^{144} and Sr^{90} were also prepared by the same technique. Thus, point sources containing isotopes of high specific activity are made available for experimental use, since they may be embedded in living tissue. By cutting microscopic tissue sections through the point occupied by the radioactive source it was possible to study the effect of various radiation dosages. Beads are prepared with activities of the order of 1 to 2 mc/mg. These beads produce a sharply defined area of liver necrosis within forty-eight hours, and the radiation effect diminishes nearly to zero at the periphery of the organ.

The authors state that the possible methods for the production of radioactive beads are (1) absorption of the radionuclide onto powdered glass, followed by fusion of small quantities of the material to form beads; (2) incorporation of the radionuclide into the raw materials used in the manufacture of glass; (3) precipitation of the radionuclide in the presence of powdered glass that can then be fused into beads. The last method was considered most satisfactory and is described and illustrated in detail. There is an error in determining the radioactivity of the beads which is probably not greater than 30 per cent.—*H. L. Jaffe, M.D.*

Pieper, George F. Instrumentation for radioactivity. *Science*, Oct. 6, 1950, *112*, 377–381.

This paper reviews the instruments required for the detection of the presence of radioisotopes. Most of these detection devices function on the principle that ionization is produced in gasses by quanta and high speed particles. The simplest of these instruments is the ionization chamber. This electrical device measures the number of ion pairs produced by a particle or quantum in passing between two electrodes. If the ionization produced by alpha particles is to be measured, the window of the chamber must be very thin. This should be less than 5 mg. per cm. sq., in order that the alpha particles may pass through the window.

A proportional counter is an ionization chamber in which the number of ion pairs is increased by collision in a region of high electric field. These counters are used when the initial ionization is lower than that which can be measured in an ordinary ionization chamber. Also they are useful when it is desired to detect one type of radiation in the presence of another.

A Geiger counter is a proportional counter in which the applied voltage is high enough for the gas multiplication of the initial ions to produce a discharge that spreads along the entire length of the wire. The common Geiger counter uses a thin wire as an anode, and a coaxial metal cylinder as a cathode. The whole arrangement is enclosed in an air tight chamber that may be evacuated and filled with suitable gasses, usually at reduced pressure. At present, Geiger counters and ionization chambers are the only radiation sensitive devices that are available in quantity and are reliable for commercial application. Recently, some scintillation counters have appeared on the market, and they probably will be increasingly available in the future. Their advantages over the Geiger counters are so great that they are preferable for most applications. All the radiation detection devices that are described in this paper require some associated electronic circuit to present the information obtained in a usable form. An amplifier may be necessary to increase the signal size. Scaling circuits are required to reduce the counting rate of a Geiger counter to a value that a mechanical register can handle. By adding an integrator circuit with a long time constant, a scaler may be converted easily into a counting rate meter.—*H. L. Jaffe, M.D.*

Freedman, Arthur J., and Hume, David N. A precision method of counting radioactive liquid samples. *Science*, Oct. 20, 1950, *112*, 461–463.

The use of radioactive isotopes in precise analytical work has been limited by lack of a method whereby samples of the radioactive material could be accurately reproduced for counting. This limitation exists in samples which contain inert solid material (carrier).

In evaporated samples minute variation of dimensions and degree of packing of the solid material causes variations in absorption and scatter. Dipping type Geiger tubes in solutions of the radioactive material are also unsatisfactory due to instability of the tubes and difficulties in decontamination of the tubes.

By using a thin lacquer film over liquid samples, these workers have been able to reduce standard deviation of the counts in the presence of carrier-ions to a point acceptable for precision analytical work.—*Robert Emerick, M.D.*

Koch, H. J., Jr., Talbot, T. R., Bernstein, M., MacKinnon, Jean, and Elias, Catherine. The effect of isotopic (I^{131}) radiation and x-radiation on the total coproporphyrin excretion in humans. *J. Clin. Endocrinol.*, Sept., 1950, *10*, 1029–1053.

Porphyrin excretions were studied on 3 patients receiving I^{131} for carcinoma of the thyroid, 1 patient receiving I^{131} for thyrotoxicosis and 2 patients receiving roentgen therapy for lymphosarcoma. One patient with no evidence of neoplasia but treated with ACTH was also studied.

The coproporphyrin extractions on urine and feces

were determined according to the method of Schwartz and Watson and to those of Dobriner.

The 2 patients with lymphosarcoma received accumulative dosages of deep roentgen therapy in excess of 3,000 r to various portals. Two of the patients receiving I^{131} were given doses of over 100 millicuries. One patient received 10 millicuries and the other a tracer dose of 500 microcuries.

An increase in total coproporphyrin to two or three times normal control values was observed in patients subjected to therapeutic amounts of roentgen therapy or radioactive iodine. This increase occurred seven to fifteen days after I^{131} treatment, and twelve to twenty days after the first dose of roentgen rays. One patient who received HN_2 following roentgen therapy showed a further increase in coproporphyrin five days after the administration of this agent. A five-fold increase in urine coproporphyrin excretion on the ninth day was found in the patient receiving ACTH.

The effects of the irradiation on the hematopoietic system with evidence of a decrease in the number of circulating lymphocytes preceded the increase in coproporphyrin excretion in all cases.

The authors conclude the article by discussing the possible causes for the increase in total coproporphyrin excretion following ionizing radiation.—*H. L. Friedell, M.D.*

WERNER, S. C., HAMILTON, H. B., LEIFER, E., and GOODWIN, L. D. An appraisal of the radioiodine tracer technic as a clinical procedure in the diagnosis of thyroid disorders; uptake measurement directly over the gland and a note on the use of thyrotropin. *J. Clin. Endocrinol.*, Sept., 1950, *10*, 1054–1076.

This study is an analysis of data obtained from 1,400 measurements on the thyroid uptake of tracer doses of I^{131}. The method used was the direct measurement of the radioactivity over the thyroid gland twenty-four hours after the oral administration of a carrier-free dose of 40 microcuries of radioiodine. In approximately 1,000 euthyroid patients, the average twenty-four hour retention of I^{131} in the thyroid was 24.4 per cent, with extremes of 3 to 55 per cent. Ninety per cent of the patients ranged between 10 and 40 per cent retention. Most of the cases which fell outside this range were above the 40 per cent retention level. In 300 studies in hyperthyroid patients, the range of uptake extended from 23 to 73 per cent, averaging 51 per cent. Eleven per cent of the cases showed less than 40 per cent retention. It is clear that some overlap exists between the upper levels of retention in euthyroid patients and the lower levels of retention in hyperthyroid patients. They also noted overlap between the lower uptake levels of the euthyroids and the thyroid uptakes of a number of hypothyroids.

An analysis of radioiodine uptake studies and basal metabolic rates was also made in 190 euthyroid patients. It was found that 21.5 per cent of the patients had basal metabolic rates above +10 per cent, whereas only 8.9 per cent of the patients exceeded a 40 per cent retention of radioiodine. It was of interest to note that individuals who had basal metabolic rates greater than +10 per cent had thyroid retentions which lay within the 10 to 40 per cent range.

Comparison of radioiodine uptakes in the thyroid and serum precipitable iodine was carried out in 80 female patients. Approximately the same percentage of cases were found to lie outside the normal limits (4 to 8 gamma per cent) as was found with the radioiodine retention studies.

When all three methods are utilized, a diagnosis of normal thyroid activity can be made with a high degree of accuracy. Using the radioiodine uptake and the basal metabolic rate in conjunction, only 3 per cent of the euthyroid patients were found to have both elevated. With the addition of the serum precipitable iodine determinations, the probability of error was apparently still further reduced.

The use of thyroid stimulating hormone as a tool in differentiating hyperthyroid from hypothyroid secondary to pituitary deficiency is discussed.

The authors conclude by stating that no refinement of a single test of thyroid function directly or indirectly will eliminate all error in separating euthyroidism from hyperthyroidism and hypothyroidism. They believe, however, that the combined use of radioiodine retention studies, basal metabolic rates and serum precipitable iodine determinations reduce the error to a minimum.—*H. L. Friedell, M.D.*

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President, Sixth International Congress of Radiology
London, England, July 23-29, 1950